General Information

What Should I Consider as I Prepare My Comments for EPA?

A. Submitting CBI

Do not submit this information to EPA through www.regulations.gov or e-mail. Clearly mark the part or all of the information that you claim to be confidential business information (CBI). For CBI information in a disk or CD ROM that you mail to EPA, mark the outside of the disk or CD ROM as CBI and then identify electronically within the disk or CD ROM the specific information that is claimed as CBI. In addition to one complete version of the comment that includes information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket. Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2.

B. Tips for Preparing Your Comments

When submitting comments, remember to:

- Explain your views as clearly as possible.
- Describe any assumptions that you used.
- Provide any technical information and/or data you used that support your views.
- If you estimate potential burden or costs, explain how you arrived at your estimate.
- Provide specific examples to illustrate your concerns.
- Offer alternatives.
- Make sure to submit your comments by the comment period deadline

identified.

- To ensure proper receipt by EPA, identify the appropriate docket identification number in the subject line on the first page of your response. It would also be helpful if you provided the name, date, and **Federal Register** citation related to your comments.

Outline of This Preamble

I. Introduction

Climate change is a serious global challenge. As detailed in section V of this notice, it is widely recognized that greenhouse gases (GHGs) have a climatic warming effect by trapping heat in the atmosphere that would otherwise escape to space. Current atmospheric concentrations of GHGs are significantly higher than pre-industrial levels as a result of human activities. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases. Future projections show that, for most scenarios assuming no additional GHG emission reduction policies, atmospheric concentrations of GHGs are expected to continue climbing for most if not all of the remainder of this century, with associated increases in average temperature. Overall risk to human health, society and the environment increases with increases in both the rate and magnitude of climate change.

Today's notice considers the potential use of the CAA to address climate change. In April 2007, the Supreme Court concluded in Massachusetts v. EPA, 127 S. Ct. 1438 (2007), that GHGs meet the CAA definition of "air pollutant," and that section 202(a)(1) of the CAA therefore authorizes regulation of GHGs subject to an Agency determination that GHG emissions from new motor vehicles cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. The Court also ruled that in deciding whether to grant or deny a pending rulemaking petition regarding section 202(a)(1), EPA must decide whether new motor vehicle GHG emissions meet that endangerment test, or explain why scientific uncertainty is so profound that it prevents making a reasoned judgment on such a determination. If EPA finds that new motor vehicle GHG emissions meet the endangerment test, section 202(a)(1) of the CAA requires the Agency to set motor vehicle standards applicable to emissions of GHGs.

EPA is also faced with the broader ramifications of any regulation of motor vehicle GHG emissions under the CAA in response to the Supreme Court's decision. Over the past several months, EPA has received seven petitions from states, localities, and environmental groups to set emission standards under Title II of Act for other types of mobile sources, including nonroad vehicles such as construction and farm equipment, ships and aircraft. The Agency has also received public comments seeking the addition of GHGs to the pollutants covered by the new source performance standard (NSPS) for several industrial sectors under section 111 of the CAA. In addition, legal challenges have been brought seeking controls for GHG emissions in preconstruction permits for several coal-fired power plants.

The interrelationship of CAA authorities and the broad array of pending and potential CAA actions concerning GHGs make it prudent to thoroughly consider how the various CAA authorities would or could work together if GHG controls were established under any provision of the Act. Since regulation of one source of GHG emissions would or could lead to regulation of other sources of GHG emissions, the Agency should be prepared to manage the consequences of CAA regulation of GHGs in the most effective and efficient manner possible under the Act.

Today's notice discusses our work to date in response to the Supreme Court's decision regarding an endangerment finding and vehicle standards under section 202 of the Act. It also includes a comprehensive examination of the potential effects of using various authorities under the Act to regulate other sources of GHG emissions. In addition, this notice examines and seeks public comment on the petitions the Agency has received for GHG regulation of additional mobile source categories. In light of the interrelationship of CAA authorities and the pending CAA actions concerning GHGs, the notice identifies and discusses possible approaches for controlling GHG emissions under the Act and the issues they raise.

Today's notice is also part of broader efforts to address the climate change challenge. Since 2001, President Bush has pursued a broad climate change agenda that has improved our understanding of climate change and its effects, spurred development of needed GHG control technologies, increased our economy's energy efficiency, and engaged other nations in efforts to foster sensible solutions to the global challenge of climate change. Building on that success, the President recently announced a new national goal: to stop the growth of U.S. GHG emissions by 2025. New actions will be necessary to meet this goal.

The President has identified several core principles for crafting any new GHG-specific legislation. EPA believes these principles are also important in considering GHG regulation under the CAA, to the extent allowed by law. These principles include addressing GHG emissions in a manner that does not harm the U.S. economy; encouraging the technological development that is essential to significantly reducing GHG emissions; and recognizing that U.S. efforts to reduce GHG emissions could be undermined if other countries with significant GHG emissions fail to control their emissions and U.S. businesses are put at a competitive disadvantage relative to their foreign competitors. Throughout this notice we discuss and seek comment on whether and how these principles can inform decisions regarding GHG regulation under the CAA.

In Congress, both the House and Senate are considering climate change legislation. A number of bills call for reducing GHG emissions from a wide variety of sources using a "cap-and-trade" approach. Many of the sources that would be subject to requirements under the bills are already subject to numerous CAA controls. Thus, there is potential for overlap between regulation under the CAA and new climate change legislation.

This ANPR performs five important functions that can help inform the legislative debate:

- First, in recognition of the Supreme Court's decision that GHGs are air pollutants under the CAA, the ANPR outlines options that may need to be exercised under the Act.
- Second, this notice provides information on how the GHG requirements under the CAA might overlap with control measures being considered for climate change legislation.
- Third, the notice discusses issues and approaches for designing GHG control measures that are useful in developing either regulations or legislation to reduce GHG emissions.
- Fourth, the ANPR illustrates the complexity and interconnections inherent in CAA regulation of GHGs. These complexities reflect that the CAA was not specifically designed to address GHGs and illustrate the opportunity for new legislation to reduce regulatory complexity. However, unless and until Congress acts, the existing CAA will be applied in its current form.
- Fifth, some sections of the CAA are inherently flexible and thus more capable of accommodating consideration of the President's principles. Other sections may not provide needed flexibility, raising serious concerns about the results of

applying them. EPA believes that the presentation in this notice of the various potential programs of the CAA will help inform the legislative debate.

EPA is following the Supreme Court's decision in Massachusetts v. EPA by seriously considering how to apply the CAA to the regulation of GHGs. In light of the CAA's interconnections and other issues explored in this notice, EPA does not believe that all aspects of the Act are well designed for establishing the kind of comprehensive GHG regulatory program that could most efficiently achieve the GHG emission reductions that may be needed over the next several decades. EPA requests comment on whether well-designed legislation for establishing a broad GHG regulatory framework has the potential for achieving greater environmental results at lower cost for many sectors of the economy, with less concern about emissions leakage and more effective, clearer incentives for development of technology, than a control program based on the CAA alone.

II. Background Information

A. Background on the Supreme Court Opinion

On October 20, 1999, the International Center for Technology Assessment (ICTA) and 18 other environmental and renewable energy industry organizations filed a petition with EPA seeking regulation of GHGs from new motor vehicles under section 202 (a)(1) of the CAA. The thrust of the petition was that four GHGs—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons (HFCs)—are air pollutants as defined in CAA section 302(g), that emissions of these GHGs contribute to air pollution which is reasonably anticipated to endanger public health or welfare, that these GHGs are emitted by new motor vehicles, and therefore that EPA has a mandatory duty to issue regulations under CAA section 202(a) addressing GHGs from these sources.

EPA denied the petition in a notice issued on August 8, 2003. The Agency concluded that it lacked authority under the CAA to regulate GHGs for purposes of global climate change. EPA further decided that even if it did have authority to set GHG emission standards for new motor vehicles, it would be unwise to do so at this time. More specifically, EPA stated that CAA regulation of CO_2 emitted by light-duty vehicles would interfere with fuel economy standards issued by the Department of Transportation (DOT) under the Energy Policy and Conservation Act (EPCA), because the principal way of reducing vehicle CO_2 emissions is to increase vehicle fuel economy. The Agency also noted in the 2003 notice that there was significant scientific uncertainty regarding the cause, extent and effects of climate change that ongoing studies would reduce. EPA further stated that regulation of climate change using the CAA would be inappropriate given the President's comprehensive climate change policies, concerns about piecemeal regulation, and implications for foreign policy.

EPA's denial of the ICTA petition was challenged in a petition for review filed in the U.S. Court of Appeals for the D.C. Circuit. Petitioners included 12 states, local governments, and a variety of environmental organizations. Intervenors in support of respondent EPA included 10 states and several industry trade associations.

The D.C. Circuit upheld EPA's denial of the petition in a 2-1 opinion (Massachusetts v. EPA, 415 F.3d 50 (D.C. Cir. 2005)). The majority opinion did not decide but assumed, for purposes of argument, that EPA had statutory authority to regulate GHGs from new motor vehicles and held that EPA had reasonably exercised its discretion in denying the petition.

In a 5-4 decision, the Supreme Court reversed the D.C. Circuit's decision and held that EPA had improperly denied ICTA's petition (Massachusetts v. EPA, 127 S. Ct. 1438 (2007)). The Court held that GHGs are air pollutants under the CAA, and that the alternative denial grounds provided by EPA were "divorced from the statutory text" and hence improper.

Specifically, the Court held that CO_2, CH_4, N_2O, and HFCs fit the CAA's definition of "air pollutant" because they are "'physical [and] chemical … substances which [are] emitted into … the ambient air.'" *Id.* at 1460. The Court rejected the argument that EPA could not regulate new motor vehicle emissions of the chief GHG, CO_2, under CAA section 202 because doing so would essentially regulate vehicle fuel economy, which is the province of DOT under EPCA. The Court held that EPA's mandate to protect public health and welfare is "wholly independent of DOT's mandate to promote energy efficiency," even if the authorities may overlap. *Id.* at 1462. The Court stated that "there is no reason to think the two agencies cannot both administer their obligations and yet avoid inconsistency." *Id.*

Turning to EPA's alternative grounds for denial, the Court held that EPA's decision on whether to grant the petition must relate to "whether an air pollutant 'causes, or contributes to, air pollution which may reasonably be anticipated to endanger public health or welfare.'" *Id.* Specifically, the Court held that generalized concerns about scientific uncertainty were insufficient unless "the scientific uncertainty is so profound that it precludes EPA from making a reasoned judgment as to whether greenhouse gases contribute to global warming." *Id.* at 1463. The Court further ruled that concerns related to piecemeal regulation and foreign policy objectives were unrelated to whether new motor vehicle GHG emissions contribute to climate change and hence could not justify the denial.

The Court remanded the decision to EPA but was careful to note that it was not dictating EPA's action on remand, and was not deciding whether EPA must find there is endangerment. Nor did the Court rule on "whether policy concerns can inform EPA's actions in the event that it makes such a finding." *Id.* The Court also observed that under CAA section 202(a), "EPA no doubt has significant latitude as to the manner, timing, content, and coordination of its regulations with those of other agencies." The Supreme Court sent the case back to the D.C. Circuit, which on September 14, 2007, vacated and remanded EPA's decision denying the ICTA petition for further consideration by the Agency consistent with the Supreme Court's opinion.

B. Response to the Supreme Court's Decision to Date

1. The President's May 2007 Announcement and Executive Order

In May 2007, President Bush announced that he was "directing the EPA and the Departments of Transportation and Energy (DOT and DOE) to take the first steps toward regulations that would cut gasoline consumption and GHG emissions from motor vehicles, using my 20-in-10 plan as a starting point." The 20-in-10 plan refers to the President's legislative proposal, first advanced in his 2007 State of the Union address, to reduce domestic gasoline consumption by 20% by 2017 through the use of renewable and alternative fuels and improved motor vehicle fuel economy.

On the same day, President Bush issued Executive Order (EO) 13432 "to ensure the coordinated and effective exercise of the authorities of the President and the heads of the [DOT], the Department of Energy, and [EPA] to protect the environment with respect to greenhouse gas emissions from motor vehicles, nonroad vehicles, and nonroad engines, in a manner consistent with sound science, analysis of benefits and costs, public safety, and economic growth."

In response to the Supreme Court's Massachusetts decision and the President's direction, EPA immediately began work with DOT and the Departments of Energy and Agriculture to develop draft proposed regulations that would reduce GHG emissions from motor vehicles and their fuels. In particular, EPA and DOT's National Highway Traffic Safety Agency (NHTSA) worked together on a range of issues related to setting motor vehicle GHG emission standards under the CAA and corporate average fuel economy (CAFE) standards under EPCA. As a prerequisite to taking action under the CAA, the Agency also compiled and reviewed the available scientific information relevant to deciding whether GHG emissions from motor vehicles, and whether GHG emissions from the use of gasoline and diesel fuel by motor vehicles and nonroad engines and equipment, cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare.

Sections V and VI of this notice provide further discussion and detail about EPA's work to date on an endangerment finding and new motor vehicle regulation under section 202 of the CAA.

2. Passage of a New Energy Law

At the same time as EPA was working with its federal partners to develop draft proposed regulations for reducing motor vehicle and fuel GHG emissions, Congress was considering broad new energy legislation that included provisions addressing the motor vehicle fuel economy and fuel components of the President's 20-in-10 legislative plan. By the end of 2007, Congress passed and the President signed the Energy Independence and Security Act (EISA). Title II of EISA amended the CAA provisions requiring a Renewable Fuels Standard (RFS) that were first established in the Energy Policy Act of 2005. EISA also separately amended EPCA with regard to the DOT's authority to set CAFE standards for vehicles.

With regard to the RFS, Congress amended section 211(o) of the CAA to increase the RFS from 7.5 billion gallons in 2012 to 36 billion gallons in 2022. There are a number of significant differences between the RFS provisions of EISA and the fuels program EPA was developing under the President's Executive Order. As a result, EPA is undertaking substantial new analytical work as part of its efforts to develop the regulations needed to implement the new RFS requirements. These regulations are subject to tight statutory deadlines.

With regard to motor vehicle regulations, EISA did not amend CAA section 202, which contains EPA's general authority to regulate motor vehicle emissions. However, EISA did substantially alter DOT's authority to set CAFE standards under EPCA. The legislation directs the Department to set CAFE standards that achieve fleet-wide average fuel economy of at least 35 miles per gallon by 2020 for light-duty vehicles, and for the first time to establish fuel economy standards for heavy-duty vehicles after a period of study.

In view of this new statutory authority, EPA and DOT have reviewed the previous regulatory activities they had undertaken pursuant to the President's May 14 directive and EO 13432. While EPA recognizes that EISA does not change the Agency's obligation to respond to the Supreme Court's decision in Massachusetts v. EPA or the scientific basis for any decision, the new law has changed the context for any action EPA might take in response to the decision by requiring significant improvements in vehicle fuel economy that will in turn achieve substantial reductions in vehicle emissions of CO_2.[25]

3. Review of CAA Authorities

[25] The Current Unified Agenda and Regulatory Plan (Regulatory Plan) available in May 2008 reflects that EPA is addressing its response to Massachusetts v. EPA as part of today's notice. The latest Regulatory Plan also contains a new entry for the renewable fuels standard program EPA is undertaking pursuant to Title II of EISA (RIN 2060-AO81). The current Regulatory Plan is available at http://www.reginfo.gov/public/do/eAgendaMain.

As part of EPA's efforts to respond to the Supreme Court's decision, the Agency conducted a thorough review of the CAA to identify and assess any other CAA provisions that might authorize regulation of GHG emission sources. That review made clear that a decision to control any source of GHG emissions could or would impact other CAA programs with potentially far-reaching implications for many industrial sectors. In particular, EPA recognized that regulation of GHG emissions from motor vehicles under section 202(a)(1) or from other sources of GHG emissions under many other provisions of the Act would subject major stationary sources to preconstruction permitting under the CAA. As discussed later in this notice, the Prevention of Significant Deterioration (PSD) program established in Part C of Title I of the Act requires new major stationary sources and modified stationary sources that significantly increase their emissions of regulated air pollutants to apply for PSD permits and put on controls to reduce emissions of those pollutants that reflect the best available control technology (BACT). Because CO_2 is typically emitted in much larger quantities relative to traditional air pollutants, CAA regulation of CO_2 would potentially extend PSD requirements to many stationary sources not previously subject to the PSD program, including large buildings heated by natural gas or oil, and add new PSD requirements to sources already subject to the program. This and other CAA implications of regulation of GHG emissions under the Act are explored later in this notice.

C. Other Pending GHG Actions under the CAA

1. Additional Mobile Source Petitions

Since the Supreme Court's Massachusetts decision, EPA has received seven additional petitions requesting that the Agency make the requisite endangerment findings and undertake rulemaking under CAA sections 202(a)(3), 211, 213 and 231 to regulate GHG emissions[26] from (1) fuels and a wide array of mobile sources including ocean-going vessels; (2) all other types of nonroad engines and equipment, such as locomotives, construction equipment, farm tractors, forklifts, harbor crafts, and lawn and garden equipment; (3) aircraft; and (4) rebuilt heavy-duty highway engines. The petitioners represent state and local governments, environmental groups, and nongovernmental organizations. Copies of these seven petitions can be found in the docket for this notice.

These petitions have several common elements. First, the petitioners state that climate change is occurring and is driven by increases in GHG emissions; that the mobile sources described in the petitions account for a significant and growing portion of these emissions; and that those mobile sources must therefore be regulated under the CAA. Second, the petitioners assert that EPA should expeditiously regulate GHG emissions from those mobile sources because they are already harming the petitioners' health and welfare and further delay by the Agency will only increase the severity of future harms to public health and welfare. Lastly, the petitioners contend that technology is currently available to reduce GHG emissions from the mobile sources for which regulation is sought.

Section VI of this notice provides a brief discussion of these petitions. The section also summarizes information on the GHG emissions of each of the

[26] While petitioners vary somewhat in their definition of GHGs, taken together they seek regulation of CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6,, water vapor, and soot or black carbon.

three mobile source categories, technologies and other strategies for reducing GHG emissions from those categories, and potential approaches for EPA to address their emissions. We request comment on all issues raised by the petitioners.

2. New Source Performance Standards

The Massachusetts decision also impacts several stationary source rulemakings. A group of state and local governments and environmental organizations petitioned the U.S. Court of Appeals for the D.C. Circuit to review a 2006 decision by EPA not to regulate the GHG emissions of several types of steam generating units when the Agency conducted the periodic review of the new source performance standard (NSPS) for those units as required by CAA section 111. EPA based its decision on the position it announced in denying the ICTA petition that the CAA does not authorize regulation of GHG emissions. After the Supreme Court ruled that the CAA does provide authority for regulating GHG emissions, the Agency filed a request with the D.C. Circuit to have the NSPS rule remanded to us for further actions consistent with the Supreme Court's opinion. Our motion was granted, and this ANPR represents the next step in our efforts to evaluate and respond to the court's decision.

Another NSPS affected by the Supreme Court's decision is the standard applicable to petroleum refineries. Pursuant to a consent decree deadline, EPA proposed revisions to the NSPS on April 30, 2007, less than one month following the Supreme Court decision. During the comment period for the review, EPA received comments calling for the NSPS to be revised to include limits on GHG emissions. In our final rule on April 30, 2008, we declined to adopt standards for GHGs at that time. First, we noted that, in the context of statutorily mandated 8-year reviews for NSPS, EPA has discretion regarding the adoption of standards for pollutants not previously covered by an NSPS. We also explained that the significant differences between GHGs and the other air pollutants for which we have previously established standards under section 111 require a more thorough and deliberate process to identify and fully evaluate the implications of a decision to regulate under this and other provisions of the CAA before deciding how to regulate GHGs under the Act. We pointed to this notice as the means for providing that process. We further noted that the time period available for proposing NSPS was too short for EPA to evaluate and develop proposed standards in light of the Massachusetts decision.

EPA also recently issued proposed revisions of the Portland cement NSPS in accordance with the schedule of a consent decree In its May 30, 2008 notice, EPA decided not to propose adding GHG emission requirements to the Portland cement NSPS for essentially the same reasons the Agency gave in deciding against adding GHG controls to the refinery NSPS.

3. Prevention of Significant Deterioration Permitting

As noted previously, the CAA's PSD program requires new major stationary sources and modified major stationary sources that significantly increase emissions to obtain air pollution permits before construction can begin. As part of the permit issuance process, the public can comment on drafts of these permits. Since the Massachusetts decision, the number and scope of issues raised by public comments on draft permits has increased.[27] The main issue that has been raised is whether EPA should be establishing facility-specific emission limits for CO_2 in these permits as a result of the Court's decision. EPA's interpretation, discussed in more detail later in this notice, is that CO_2 is not a regulated pollutant under the Act and that we therefore currently lack the legal authority to establish emission limits for this pollutant in PSD permits. That interpretation has been challenged to EPA's Environmental Appeals Board, and we anticipate a decision in this case later this year.[28] The Appeals Board's decision could also affect several other permits awaiting issuance by EPA, and may have significant implications for the entire PSD program. The broader consequences of CO_2 and other GHGs being classified as a regulated pollutant are discussed later in this notice.

EPA has also received other GHG related comments related to other elements of the PSD program, such as the consideration of GHG emissions in establishing controls for other pollutants, the consideration of alternatives to the proposed project, and related issues. EPA is currently considering these comments in the context of evaluating each PSD permit application on a case-by-case basis, applying current law.

4. GHG Reporting Rule

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[27] Most PSD permits are issued by states under EPA-approved state rules. Other states without approved rules can also issue permits on behalf of EPA under delegation agreements. EPA is the permitting authority in New York, Massachusetts, Washoe Co (Nevada), Puerto Rico, Guam, American Samoa, and the Virgin Islands. EPA also issues PSD permits for sources on tribal lands.

[28] See, In Re Deseret Power Electric Cooperative, PSD Appeal No. 07-03 (http://www.epa.gov/region8/air/permitting/deseret.html).

In EPA's most recent appropriations bill, Congress called on EPA to develop and issue a mandatory GHG emissions reporting rule by the middle of 2009.[29]

Accordingly, EPA is now developing a proposed rule that would collect emissions and emissions-related information from stationary and mobile sources. The overall purpose of the rule is to obtain comprehensive and accurate GHG data relevant to future climate policy decisions, including potential regulation under the CAA. EPA expects the rule to provide valuable additional information on the number and types of U.S. GHG sources and on the GHG emission levels of those sources.

D. Today's Action

In view of the interrelationship of CAA authorities and the many pending CAA actions concerning GHGs before the Agency, EPA decided to issue this ANPR to elicit information that will assist us in developing and evaluating potential action under the CAA. In this ANPR, we review the bases for a potential endangerment finding in the context of the pending petition concerning new motor vehicles, explore interconnections between CAA provisions that could lead to broader regulation of GHG emissions, and examine the full range of potential CAA regulation of GHGs, including a discussion of the issues raised by regulation of GHG emissions of mobile and stationary sources under the Act. The ANPR will help us shape an overall approach for potentially addressing GHG emissions under the CAA as part of a broader set of actions to address GHG

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[29] The fiscal year 2008 Consolidated Appropriations Act states that "not less than $3,500,000 shall be provided for activities to develop and publish a draft rule not later than 9 months after the date of enactment of this Act, and a final rule not later than 18 months after the date of enactment of this Act, to require mandatory reporting of greenhouse gas emissions above appropriate thresholds in all sectors of the economy…"

emissions taken by Congress, EPA, other federal departments and agencies, state and local governments, the private sector, and the international community.

III. Nature of Climate Change and Greenhouse Gases and Related Issues for Potential Regulation

Much of today's notice is devoted to a detailed examination of the various CAA authorities that might be used to regulate GHG emissions and the scientific and technical bases for potentially exercising those authorities. A key question for EPA is whether and how potentially applicable CAA provisions could be used to regulate GHG emissions in an effective and efficient manner in light of the terms of those provisions. The global nature of climate change, the unique characteristics of GHGs, and the ubiquity of GHG emission sources present special challenges for regulatory design. In this section of the notice, we identify and discuss these and several other important considerations that we believe should inform our examination and potential use of CAA authorities. Throughout this notice we ask for comment on whether particular CAA authorities would allow EPA to develop regulations that address those considerations in an effective and appropriate manner.

A. Key Characteristics of Greenhouse Gases

The six major GHGs of concern are those directly emitted by human activities. These are CO_2, CH_4, N_2O, HFCs, perfluorocarbons (PFCs), and sulfur hexafluoride

(SF_6). GHGs have a climatic warming effect by trapping heat in the atmosphere that would otherwise escape to space.

Global emissions of these six GHGs have grown since pre-industrial times and particularly over recent decades, having increased by 70% between 1970 and 2004.[30] In 2000, U.S. GHG emissions accounted for approximately 21% of the global total. Other major emitting countries include China, the Russian Federation, Japan, Germany, India and Brazil. Future projections show that, for most scenarios assuming no additional GHG emission reduction policies, global atmospheric concentrations of GHGs are expected to continue climbing for most if not all of the remainder of this century and to result in associated increases in global average temperature. The Intergovernmental Panel on Climate Change (IPCC) projects an increase of global GHG emissions by 25 to 90% between 2000 and 2030 under a range of different scenarios. For the U.S., under a business as usual scenario, total gross GHG emissions are expected to rise 30 percent between 2000 and 2020.[31]

A significant difference between the major GHGs and most air pollutants regulated under the CAA is that GHGs have much longer atmospheric lifetimes.[32] Once emitted, GHGs can remain in the atmosphere for decades to centuries while traditional air pollutants typically remain airborne for days to weeks. The fact that GHGs remain in the atmosphere for such long periods of time has several important and related consequences:

(1) Unlike most traditional air pollutants, GHGs become well mixed throughout the global atmosphere so that the long-term distribution of GHG concentrations is not

[30] The data provided here come from "Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)" - Summary for Policymakers.
[31] Fourth U.S.Climate Action Report, 2007. http://www.state.gov/g/oes/rls/rpts/car/.
[32] Some pollutants regulated under the CAA have long atmospheric lifetimes, including those regulated for protection of stratospheric ozone and mercury.

dependent on local emission sources. Instead, GHG concentrations tend to be relatively uniform around the world.

(2) As a result of this global mixing, GHGs emitted anywhere in the world affect climate everywhere in the world. U.S. GHG emissions have climatic effects not only in the U.S. but in all parts of the world, and GHG emissions from other countries have climatic effects in the U.S.

(3) Emissions of the major GHGs build up in the atmosphere so that past, present and future emissions ultimately contribute to total atmospheric concentrations. While concentrations of most traditional air pollutants can be reduced relatively quickly (over months to several years) once emission controls are applied, atmospheric concentrations of the major GHGs cannot be so quickly reversed. Once applied, GHG emission controls would first reduce the rate of build-up of GHGs in the atmosphere and, depending on the degree of controls over the longer term, would gradually result in stabilization of atmospheric GHG concentrations at some level.

(4) GHG emissions have long-term consequences. Once emitted, the major GHGs exert their climate changing effects for a long period of time. Past and current GHG emissions thus lead to some degree of commitment to climate change for decades or even centuries. According to the IPCC, past GHG emissions have already resulted in an increase in global average temperature and associated climatic changes. Much of those past emissions will continue to contribute to temperature increases for some time to come, while current and future GHG emissions contribute to climate change over a

similarly long period. See section V for a fuller discussion of the effects of GHG emissions as they relate to making an endangerment finding under the CAA.[33]

The large temporal and spatial scales of the climate change challenge introduce regulatory issues beyond those typically presented for most traditional air pollutants. Decision makers are faced with many uncertainties over long time frames and across national boundaries, such as population and economic growth, technological change, the exact rate and magnitude of climate change in response to different emissions pathways, and the associated effects of that climate change. These uncertainties increase the complexity of designing an effective long-term regulatory strategy.

Acknowledging that overall risk increases with increases in both the rate and magnitude of climate change, the United Nations Framework Convention on Climate Change (UNFCCC), signed and ratified by the U.S. in 1992, states as its ultimate objective the "…stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." In 2007, the U.S. and other Parties to the UNFCCC recognized that "...deep cuts in global emissions will be required to achieve the ultimate objective of the Convention..." and emphasized "...the urgency to address climate change as indicated…" by the IPCC.

Determining what constitutes "dangerous anthropogenic interference" is not a purely scientific question; it involves important value judgments regarding what level of climate change may or may not be acceptable. It is not the purpose of this ANPR to make any judgment regarding what an appropriate stabilization goal may be. In the absence of further policy action, the IPCC notes that, "With current climate change

[33] Another important difference between CO_2 and traditional air pollutants is the high volume of CO_2 emissions relative to other pollutants for most sources. The significance of this difference is discussed later in this section and in section VII of this notice.

mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades."

As indicated above, to stabilize GHGs at any level in the atmosphere, emissions would need to peak and decline thereafter. A decision to stabilize at lower concentrations and associated temperature increases would necessarily advance the date by which emissions would need to peak, and would therefore require greater emissions reductions earlier in time. According to the IPCC, mitigation efforts over the next two to three decades will have a large impact on the ability of the world to achieve lower stabilization levels. For illustration, IPCC projected that, in order to prevent long-term global temperatures from exceeding 2.8ºC (approximately 5ºF) relative to pre-industrial temperatures, atmospheric CO_2 concentrations would need to be stabilized at 440 parts per million (ppm) (current levels stand at about 379 ppm), translating into global CO_2 emission reductions by 2050 of up to 60% (relative to emissions in the year 2000). Stabilization targets that aim to prevent even more warming would require steeper and earlier emission reductions, whereas stabilization targets that allow for more warming (with higher associated risks and impacts) would require less steep and later emission reductions.

B. Types and Relative Emissions of GHG Emission Sources

1. Background

Each year EPA prepares a complete inventory of the anthropogenic emissions and sinks of all six major GHGs in the United States.[34] Anthropogenic in this context means that emissions result from human activities. "Sinks" are the opposite of emissions in that they are activities or processes that remove GHGs from the atmosphere (e.g., CO_2 uptake by plants through photosynthesis). EPA prepares the inventory in cooperation with numerous federal agencies as part of the U.S. commitment under the UNFCCC.[35] This inventory is derived largely from top-down national energy and statistical data. As mentioned previously, EPA is currently developing a proposed GHG reporting rule that will provide bottom-up data from covered reporters and thus provide greater detail on the emissions profile of specific source categories.

2. Emissions by Gas

In 2006, total U.S. GHG emissions were 7,054 million metric tons of CO_2 equivalent ($MMTCO_2e$).[36] Overall, total U.S. GHG emissions have risen by 14.7 % from 1990 to 2006. GHG emissions decreased from 2005 to 2006 by 1.1 percent (or 76 $MMTCO_2e$). Figure III-1 illustrates the relative share of each gas, and trend since 1990,

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[34] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, (April 2008) USEPA #430-R-08-005. http://www.epa.gov/climatechange/emissions/usinventoryreport.html.

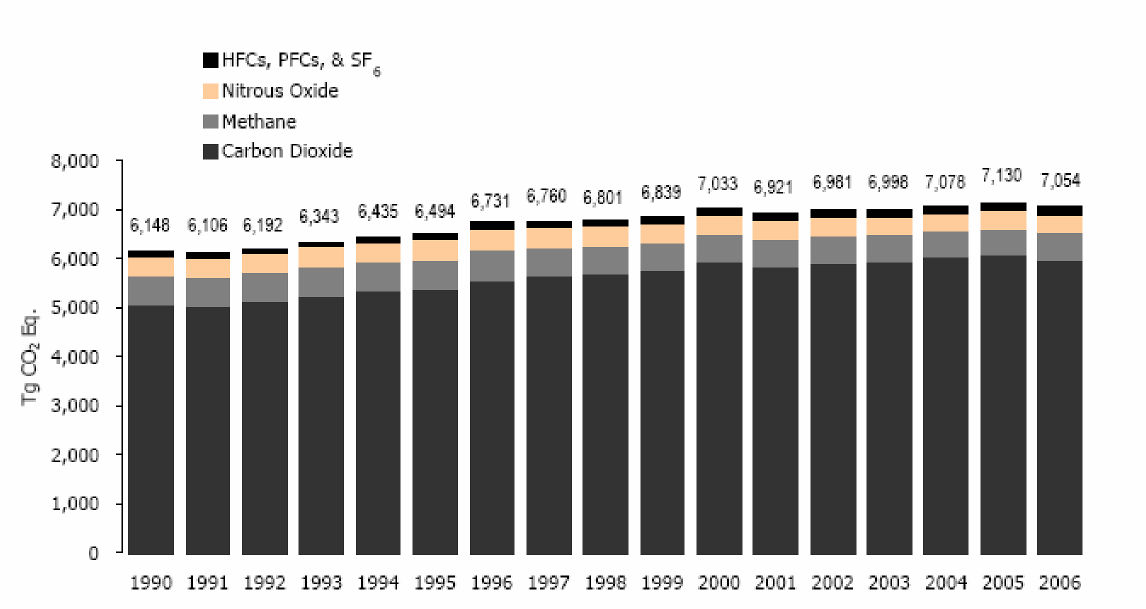
[35] See Articles 4 and 12 of the UNFCCC treaty. www.unfccc.int. Parties to the Convention "shall develop, periodically update, publish and make available…national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies…"

[36] International standards for reporting are established by the IPCC, which uses metric units. 1 $MMTCO_2e$ is equal to 1 teragram (Tg) or 10^{12} grams. 1 metric ton is equal to 1.1023 short tons.

weighted by global warming potential.[37] All GHG units and percentage changes provided in this section are based on CO_2-equivalency.

[37] Emissions of different GHGs are compared using global warming potentials (GWPs). The GWP of a GHG is the ratio of heat trapped by one unit mass of the GHG compared to that of one unit mass of CO2 over a specified time period, which is 100 years for the GWPs estimated by the IPCC used here. The reference gas is CO_2, and therefore GWP-weighted emissions are measured in teragrams of CO_2 equivalent (Tg CO_2 Eq.). The GWP values used in this analysis come from the IPCC Second Assessment report, consistent with the UNFCCC reporting requirements for Parties listed in Annex I.

Figure III-1


HFCs, PFCs, & SF6
Nitrous Oxide
Methane
Carbon Dioxide
Tg CO2 Eq.
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
6,148
6,106
6,192
6,343
6,435
6,494
6,731
6,760
6,801
6,839
7,033
6,921
6,981
6,998
7,078
7,130
7,054
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

Carbon Dioxide: The primary GHG emitted as a result of human activities in the United States is CO_2, representing approximately 85% of total GHG emissions. CO_2 results primarily from fossil fuel combustion to generate electricity, power vehicles and factories, heat buildings, etc. Fossil fuel-related CO_2 emissions accounted for approximately 79% of CO_2 emissions since 1990, and increased at an average annual rate of 1.1% from 1990 to 2006. Changes in CO_2 emissions from fossil fuel combustion are influenced by many long-term and short-term factors, including population and economic growth, energy price fluctuations, technological changes, and seasonal temperatures.

Methane: According to the IPCC, CH_4 is more than 20 times as effective as CO_2 at trapping heat in the atmosphere. By 2006, CH_4 emissions had declined from 1990 levels by just under 9%, and now make up approximately 8% of total U.S. GHG emissions. Enteric fermentation (22.7%) is the largest anthropogenic source of CH_4 emissions in the United States, followed by landfills (22.6%), natural gas systems (18.4%), coal mining (10.5%), and manure management (7.5%). Smaller sources such as rice cultivation and incomplete fossil fuel combustion account for the remainder.

Nitrous Oxide: While total N_2O emissions are much lower than CO_2 emissions in terms of mass, N_2O is approximately 300 times more powerful than CO_2 at trapping heat in the atmosphere. U.S. emissions of N_2O are just over 5% of total U.S. GHG emissions, and have declined by 4% since 1990. The main anthropogenic activities producing N_2O in the United States are agricultural soil management (72%), and fuel combustion in motor vehicles (9%). A variety of chemical production processes and liquid waste management sources also emit N_2O.

HFCs, PFCs, and SF_6: These GHGs are often grouped together because they contain fluorine, typically have large global warming potentials, and are produced only through human activities (there are no natural sources), either intentionally for use or unintentionally as an industrial byproduct. HFCs and some PFCs are increasingly being used – and therefore emitted - as substitutes for the ozone depleting substances controlled under the Montreal Protocol and Title VI of the CAA. The largest source is the use of HFCs in air conditioning and refrigeration systems. Other sources include HFC-23 emitted during the production of HCFC-22, electrical transmission and distribution systems (SF_6), and PFC emissions from semiconductor manufacturing and primary aluminum production. U.S. HFC emissions have increased 237% over 1990 levels, while emissions of PFCs and SF_6 have decreased by 71 and 47%, respectively, from 1990 levels. Combined, these GHGs made up 2.1% of total U.S. GHG emissions in 2006.

3. Emissions by Sector

An alternative way to look at GHG emissions is by economic sector. All U.S. GHG sources can be grouped into the electricity, industrial, commercial, residential, transportation and agriculture sectors. Additionally, there are changes in carbon stocks that result in emissions and sinks associated with land-use and land-use change activities. Figure III-2 illustrates the relative contributions and historical trends of these economic sectors.

Electricity Generation: The electricity generation sector includes all facilities that generate electricity primarily for sale rather than for use on site (e.g., most large-scale power plants). Electricity generators emitted 33.7% of all U.S. GHG emissions in 2006. The type of fuel combusted by electricity generators has a significant effect on their emissions. For example, some electricity is generated with low or no CO_2 emitting energy technologies, particularly non-fossil options such as nuclear, hydroelectric, or geothermal energy. However, over half of the electricity in the U.S. is generated by burning coal, accounting for 94% of all coal consumed for energy in the U.S. in 2006.

Transportation Sector: The transportation sector includes automobiles, airplanes, railroads and a variety of other sources. Transportation activities (excluding international bunker fuels) accounted for approximately 28% of all GHG emissions in 2006, primarily through the combustion of fossil fuels.[38] Virtually all of the energy consumed in this end-use sector came from petroleum products. Over 60% of the CO_2 emissions resulted from gasoline consumption for personal vehicle use.

Industrial Sector: The industrial sector includes a wide variety of facilities engaged in the production and sale of goods. The largest share of emissions from industrial facilities comes from the combustion of fossil fuels. Emissions of CO_2 and other GHGs from U.S. industry also occur as a result of specialized manufacturing processes (e.g., calcination of limestone in cement manufacturing). The largest emitting industries tend to be the most energy intensive: iron and steel, refining, cement, lime, chemical manufacturing, etc. Overall, 19.4% of total U.S. GHG emissions came from the industrial sector in 2006.

Residential and Commercial Sectors: These two sectors directly emit GHGs primarily through operation and maintenance of buildings (i.e., homes, offices, universities etc.). The residential and commercial end-use sectors accounted for 4.8 and 5.6% of total

[38] International bunker fuels are used in aviation and marine trips between countries.

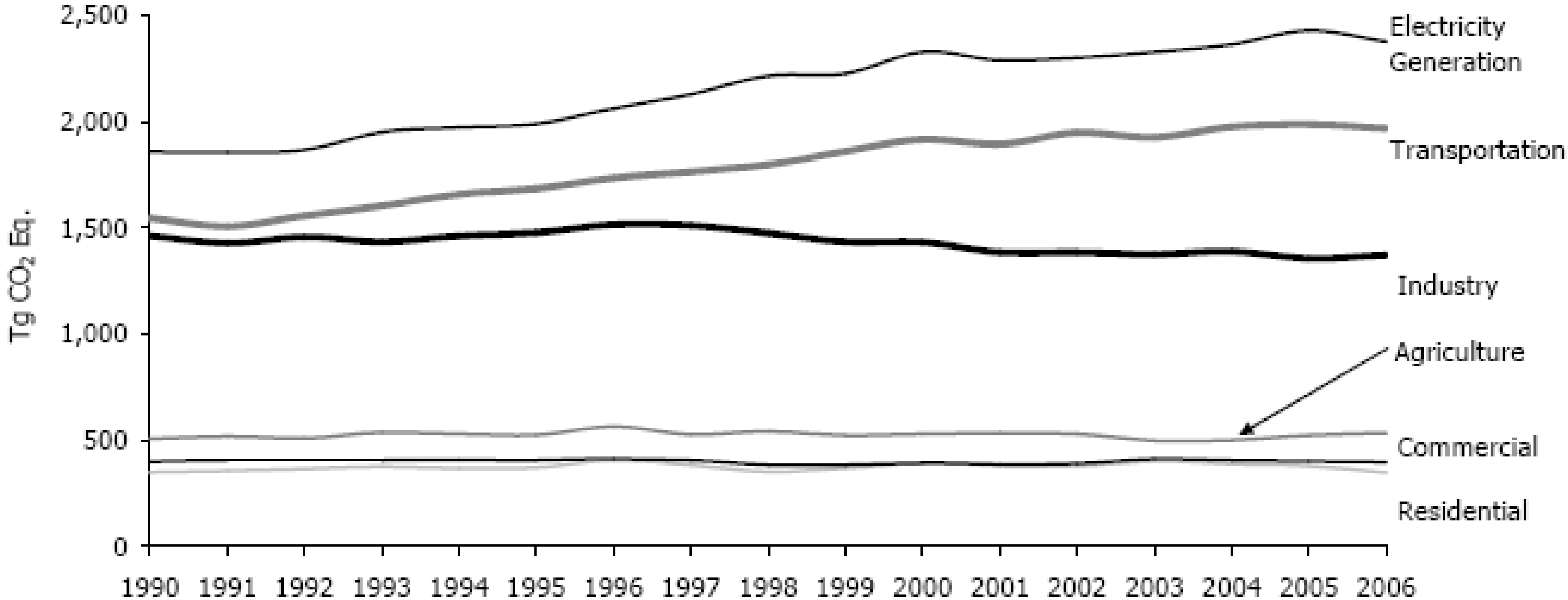
emissions, respectively, with CO_2 emissions from consumption of natural gas and petroleum for heating and cooking making up the largest share.

Agriculture Sector: The agriculture sector includes all activities related to cultivating soil, producing crops, and raising livestock. Agricultural GHG emissions result from a variety of processes, including: enteric fermentation in domestic livestock, livestock manure management, rice cultivation, agricultural soil management, and field burning of agricultural residues. Methane and N_2O are the primary GHGs emitted by agricultural activities.[39] In 2006, agriculture emission sources were responsible for 6.4% of total U.S. GHG emissions.

Land Use, Land-Use Change, and Forestry: Land use is not an economic sector per se but affects the natural carbon cycle in ways that lead to GHG emissions and sinks. Included in this category are emissions and sequestration of CO_2 from activities such as deforestation, afforestation, forest management and management of agricultural soils. Emissions and sequestration depend on local conditions, but overall land use in the U.S. was a net sink in 2006 equivalent to 12.5% of total GHG emissions.

[39] Agricultural soils also emit CO_2 and sequester carbon. The fluxes are discussed under the Land-Use, Land-Use Change and Forestry section because of the integrated nature of methodological approaches to the carbon cycle, and international reporting conventions.

Figure III-2



2,500
2,000
1,500
1,000
500
0
Tg CO_2 Eq.
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Electricity Generation
Transportation
Industry
Agriculture
Commercial
Residential

C. Advancing Technology

President Bush, the IPCC, and many other private and public groups have spotlighted the critical importance of technology to reducing GHG emissions and the risks of climate change. International, U.S., and private studies have identified a broad range of potential strategies that can reduce emissions from diverse economic sectors. Many strategies, such as increasing energy efficiency and conservation and employing hybrid and diesel vehicle technologies, are available today. There is also broad consensus that for many sectors of the economy new technologies will be needed to achieve deep reductions in GHG emissions at less cost than today's technologies alone can achieve.

In developing potential CAA (or other) controls, one important question is the extent to which needed technological development can be expected to occur as a result of market forces alone (e.g., as a result of increasing prices for oil and other fossil fuels), and the extent to which government or other action may be needed to spur development. There are several different pathways for technological change, including investment in research and development (private and public), spillovers from research and development in other sectors (e.g., advances in computing made hybrid vehicles possible), learning by doing (i.e., efficiency gains through repetition), and scale economies (i.e., aggregate cost reductions from improved process efficiencies). As further discussed later in this section, market-based incentives that establish a price (directly or indirectly through a limit) for carbon and/or other GHGs could continuously spur technological innovation that could lower the cost of reducing emissions. However, even with such a policy, markets tend to under-invest in development of new technologies when investors can only capture a portion of the returns. This is particularly true at the initial stages of research and development when risks are high and market potential is not evident. In such cases, policies to encourage the development and diffusion of technologies that are complements to pollution control policies may be warranted.[40]

This section draws insights from IPCC and other reports on available and needed technologies. In later sections of this notice, we explain each potentially applicable CAA provision and consider the extent to which that provision authorizes regulatory actions and approaches that could spur needed technology development.

1. The Role of Existing and New Technology in Addressing Climate Change

The 2007 IPCC report on mitigation of climate change examined the availability of current technologies and the need for new technologies to mitigate climate change.[41] Among its conclusions, the IPCC states:

- *The range of stabilization levels assessed [by the IPCC] can be achieved by deployment of a portfolio of technologies that are currently available and those that are expected to be commercialized in coming decades. This assumes that appropriate and effective incentives are in place for development, acquisition,*

[40] Economic Report of the President, February 2007.
[41] IPCC, 2007, "Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change," [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyers (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY.

deployment and diffusion of technologies and for addressing related barriers.[42]

According to one study, five groups of strategies that could substantially reduce emissions between now and 2030 include 1) improving energy efficiency in buildings and appliances; 2) increasing fuel efficiency and reducing GHG emissions from vehicles and the carbon intensity of transportation fuels; 3) industrial equipment upgrades and process changes to improve energy efficiency; 4) increasing forest stocks and improving soil management practices; and 5) reducing carbon emissions from electric power production through a shift toward renewable energy, expanded nuclear capacity, improved power plant efficiency, and use of carbon capture and storage technology on coal-fired generation.[43] (Note that EPA is not rank-ordering these technologies by their relative cost effectiveness.) As noted elsewhere in this notice, there is federal regulatory or research and development activity ongoing in most of these areas.

Many energy efficiency technologies exist that appear to be extremely cost-effective in reducing fuel costs compared to other alternatives. However, they have yet to be adopted as widely as expected because of market barriers. Such barriers include lack of knowledge or confidence in the technology by potential users, uncertainty in the return on investment (potentially due to uncertainty in either input prices or output prices), concerns about effects of energy efficiency technologies on the quality of inputs or outputs, size of the initial capital investment (coupled with potential liquidity constraints), and requirements for specialized human capital investments. Some of these

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[42] Ibid, "Summary for Policymakers," p. 25.

[43] See McKinsey & Company, "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?", U.S. Greenhouse Gas Abatement Mapping Initiative, Executive Report, December 2007. This study performed an economic assessment of potential control methods based on a "bottom-up" partial equilibrium model, which does not account for interactions among economic sectors. Bottom-up models include many more specific technologies than "top-down" general equilibrium models, which account for cross-sector interactions.

costs are lower in larger firms, due to the increased availability of financial resources and human capital.[44] Vendor and other projections of cost-savings for energy efficiency technologies are often based on average pay-back and thus do not reflect differences among firms that can affect the costs and benefits of these technologies and therefore the likelihood of adoption. Over time, as firms gain more experience with these technologies, the rate of adoption will likely increase if significant cost-savings are realized by early adopters.

The IPCC report on mitigation identified technologies that are currently available and additional technologies that are expected to be commercialized by 2030, as shown in the following table.[45] These include technologies and practices in the energy supply, transportation, buildings, industry, agriculture, forest, and waste sectors:

[44] Pizer, et al., "Technology Adoption and Aggregate Energy Efficiency," December 2002, December 2002 • Resources for the Future Discussion Paper 02–52.
[45] IPCC 2007, "Summary for Policymakers," p. 14.

Figure III-3

Table SPM 3: *Key mitigation technologies and practices by sector. Sectors and technologies are listed in no particular order. Non-technologica practices, such as lifestyle changes, which are cross-cutting, are not included in this table (but are addressed in paragraph 7 in this SPM).*

Sector	**Key mitigation technologies and practices currently commercially available.**	**Key mitigation technologies and practices projected to be commercialized before 2030.**
Energy Supply [4.3, 4.4]	Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power (hydropower, solar, wind, geothermal and bioenergy); combined heat and power; early applications of CCS (e.g. storage of removed CO_2 from natural gas)	Carbon Capture and Storage (CCS) for gas, biomass and coal-fired electricity generating facilities; advanced nuclear power; advanced renewable energy, including tidal and waves energy, concentrating solar, and solar PV.
Transport [5.4]	More fuel efficient vehicles; hybrid vehicles; cleaner diesel vehicles; biofuels; modal shifts from road transport to rail and public transport systems; non-motorised transport (cycling, walking); land-use and transport planning	Second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries
Buildings [6.5]	Efficient lighting and daylighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves, improved insulation ; passive and active solar design for heating and cooling; alternative refrigeration fluids, recovery and recycle of fluorinated gases	Integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control; solar PV integrated in buildings
Industry [7.5]	More efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; control of non-CO_2 gas emissions; and a wide array of process-specific technologies	Advanced energy efficiency; CCS for cement, ammonia, and iron manufacture; inert electrodes for aluminium manufacture
Agriculture [8.4]	Improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management to reduce CH_4 emissions; improved nitrogen fertilizer application techniques to reduce N_2O emissions; dedicated energy crops to replace fossil fuel use; improved energy efficiency	Improvements of crops yields
Forestry/forests [9.4]	Afforestation; reforestation; forest management; reduced deforestation; harvested wood product management; use of forestry products for bioenergy to replace fossil fuel use	Tree species improvement to increase biomass productivity and carbon sequestration. Improved remote sensing technologies for analysis of vegetation/ soil carbon sequestration potential and mapping land use change
Waste [10.4]	Landfill methane recovery; waste incineration with energy recovery; composting of organic waste; controlled waste water treatment; recycling and waste minimization	Biocovers and biofilters to optimize CH_4 oxidation

How much any of the mitigation strategies identified by these studies would actually be deployed to address climate change is an open question. It is possible that unanticipated technologies could play a significant role in reducing emissions. The point of these studies is to illustrate that potentially feasible technologies exist that could be employed to mitigate GHG emissions, not to predict the precise role they will play or to suggest sectors or methods for regulation. The particular policies pursued by governments, including the U.S. under the CAA or other authorities, will influence the way in which these technologies are deployed as well as incentives for developing and deploying new technologies.

2. Federal Climate Change Technology Program

The U.S. government is investing in a diverse portfolio of technologies with the potential to yield substantial reductions in emissions of GHGs. The Climate Change Technology Program (CCTP) is a multi-agency planning and coordination entity that assists the government in carrying out the President's National Climate Change Technology Initiative. Managed by the Department of Energy, the program is organized around five technology areas for which working groups were established. EPA participates in all of the working groups and chairs the group focused on non-CO_2 GHGs.

The CCTP strategic plan, released in September 2006, provides strategic direction and organizes approximately $3 billion in federal spending for climate change-related technology research, development, demonstration, and deployment.[46] The plan sets six complementary goals, including five aimed at developing technologies to:

- reduce emissions from energy end-use and infrastructure;
- reduce emissions from energy supply, particularly through development and commercialization of no- or low-emission technologies;
- capture, store and sequester CO2;
- reduce emissions of non-CO2 GHGs; and
- enhance the measurement and monitoring of CO2 emissions.

The first four of these goals focus on GHG emissions reduction technologies, and the fifth addresses a key need for developing comprehensive GHG control strategies. The sixth CCTP goal is to strengthen the contributions of basic science to climate change technology development.

3. Potential for CAA regulation to encourage technology development

Past EPA efforts to reduce air pollution under the CAA demonstrate that incentives created by regulation can help encourage technology development and deployment. As noted in a recent EPA regulatory analysis, the history of the CAA provides many examples in which technological innovation and "learning by doing" have made it possible to achieve greater emissions reductions than had been feasible earlier, or have reduced the costs of emission control in relation to original estimates.[47] Among the

[46]U.S. Climate Change Technology Program Strategic Plan, September 2006; http://www.climatetechnology.gov/stratplan/final/index.htm
[47] See section 5.4 of *Final Ozone NAAQS Regulatory Impact Analysis*, March 2008, EPA-HQ-OAR-2007-0225. The RIA is available at http://www.epa.gov/ttn/ecas/ria.html#ria2007..

examples are motor vehicle emission controls, diesel fuel and engine standards to reduce NOx and particulate matter emissions, engine idle-reduction technologies, selective catalytic reduction and ultra-low NOx burners for NOx emissions, high-efficiency scrubbers for SO2 emissions from boilers, CFC-free air conditioners and refrigerators, low or zero VOC paints, and idle-reduction technologies for engines.[48]

One of the issues raised by potential CAA regulation of GHGs is whether the CAA can help spur needed technological development for reducing GHG emissions and the costs of those reductions. The regulatory authorities in the CAA vary in their potential for encouraging new technology. As discussed later in this notice , some provisions offer little flexibility in standard-setting criteria, emission control methods, compliance deadlines and potential for market-oriented regulation. Other provisions offer more potential to encourage new technology through market incentives or to establish standards based on anticipated advances in technology. EPA requests comment on the extent to which various CAA provisions could be used to help spur technological development, and on the need for federally conducted or funded research to promote technological development.

D. Relationship to Traditional Air Pollutants and Air Pollution Controls

An issue for any regulation of GHGs under the CAA or other statutory authority is how a GHG control program would and should interact with existing air quality management programs. This section describes the relationships between climate change and air quality and between GHG emissions and traditional air pollution control

[48] Ibid.

programs. As explained below, those relationships suggest the need for integrated approaches to climate change mitigation and air quality protection. Differences between GHGs and traditional air pollutants should also be taken into account in considering how CAA authorities could be employed for GHG regulation.

1. Connections between Climate Change and Air Quality Issues

Climate change affects some types of air pollution, and some traditional air pollutants affect climate. According to the IPCC, climate change can be expected to influence the concentration and distribution of air pollutants through a variety of direct and indirect processes. In its recent review of the NAAQS for ozone, EPA examined how climate change can increase ozone levels and how ozone, itself a GHG, can contribute to climate change. Similarly, in its reviews of the NAAQS for particulate matter, the Agency examined the extent to which some particles help absorb solar energy in the earth's atmosphere and others help reflect it back to space.[49] How EPA regulates those pollutants under the CAA is potentially part of an overall strategy for addressing climate change, and how GHGs are regulated is potentially an important component of protecting air quality. For example, it is likely to become more difficult and expensive to attain the ozone NAAQS in a future, warmer climate.

Most of the largest emitters of GHGs are also large emitters of traditional air pollutants and therefore are already regulated under the CAA. The electricity generation, transportation and industrial sectors, the three largest contributors to GHG emissions in

[49] EPA did not have adequate information in these reviews for impacts on climate change to change the Agency's decision on whether or how to revise the standards. *See, e.g.*, 71 FR 61144, 61209-10 (October 17, 2006) (PM NAAQS review).

the U.S., are subject to CAA controls to help meet NAAQS, control acid rain, and reduce exposures to toxic emissions. Some manufacturers of the GHGs that are fluorinated gases are subject to CAA regulations for protection of the stratospheric ozone layer.

Many measures for controlling GHG emissions also contribute to reductions in traditional air pollutants, and some measures for controlling traditional air pollutants result in reductions in GHGs.[50] Co-benefits from reduced air pollution as a result of actions to reduce GHG emissions can be substantial.[51] In general, fossil fuel combustion results in emissions not only of CO2 but also of many traditional air pollutants, including SO_2, NOx, CO and various toxic air pollutants. For many types of sources, to the extent fossil fuel combustion is reduced, emissions of all those pollutants are reduced as well. Some control measures reduce GHGs and traditional air pollutants, including leak detection and fuel switching. However, some measures for controlling traditional air pollutants increase GHGs, and some measures for controlling GHGs may increase traditional air pollutants. For example, controls to decrease SO_2 emissions from industrial sources require energy to operate and result in reduced process efficiencies and increases in GHGs, and changing the composition of transportation fuels to reduce GHGs may affect traditional air pollutant emissions.

By considering policies for addressing GHGs and traditional air pollutants in an integrated manner, EPA and the sectors potentially subject to GHG emission controls would also have the opportunity to consider and pursue the most effective way of accomplishing emission control across pollutants. For example, adoption of some air quality controls could result in a degree of “technology lock-in” that restricts the ability

[50] EPA, OAP, Clean Energy-Environmental Guide to Act, http://www.epa.gov/cleanenergy/documents/gta/guide_action_full.pdf.
[51] IPCC, 2007, Working Group III, Summary for Policymakers.

to implement GHG control technologies for significant periods of time because of the investment in capital and other resources to meet the air quality control requirements. Sections VI and VII below discuss technologies and opportunities for controlling GHGs in more detail from various sectors, including transportation, electricity generation, and manufacturing. EPA requests comment on strategies and technologies for simultaneously achieving reductions in both traditional air pollutants and GHG emissions.

In light of the connections between climate change and air quality, the large overlap of GHG and traditional air pollution sources, and the potential interactions of GHG and traditional air pollution controls, it makes sense to consider regulation of GHGs and traditional air pollutants in an integrated manner. Indeed, the National Academy of Sciences recommends that development of future policies for air pollution control be integrated with climate change considerations.[52] GHG control measures implemented today could have immediate impacts on air pollution and air quality. Similarly, air pollution controls implemented today could have near term impacts on GHG emissions and thus long term impacts on climate. Ideally, any GHG control program under the Act, or other statutory authority would address GHGs in ways that simultaneously reduce GHGs and traditional air pollutants as needed to mitigate climate change and air pollution.[53]

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[52] National Academy of Sciences, "Radiative Forcing of Climate Change: Expanding the Concept and Addressing Uncertainties," October 2005.

[53] Integration of planning efforts related to air quality, land use, energy efficiency, and transportation to improve air quality and reduce GHG emissions is in line with the CAA Advisory Committee Air Quality Management Subcommittee's Phase II recommendations (June 2007), and the recommendations of the National Research Council of the National Academy of Sciences in its January 2004 report, "Air Quality Management in the United States." EPA has initiated several programs to encourage integrated planning efforts, including the Sustainable Skylines Initiative, a public-private partnership to reduce air emissions and promote sustainability in urban environments, and the Air Quality Management Plan pilot program for testing a comprehensive, multipollutant planning approach.

2. Issues in Applying CAA Controls to GHGs

One important issue for regulation of GHGs under some CAA provisions concerns the emissions thresholds established by the Act for determining the applicability of those provisions. Several CAA provisions require stationary sources that emit traditional air pollutants above specific emission thresholds to comply with certain requirements. Applying the same thresholds to GHGs could result in numerous sources, such as space heaters in large residential and commercial buildings, becoming newly subject to those requirements. Currently regulated sources could become subject to additional requirements. This would occur in part because most sources typically emit CO2, the predominant GHG, in much larger quantities than traditional air pollutants. Issues related to threshold levels are discussed in more detail in Section VII below.

Other important issues for CAA regulation of GHGs are raised by the different temporal and spatial scope of GHGs compared to traditional pollutants. Air pollutants currently regulated under the CAA tend to have local (a few kilometers) or regional (hundreds to thousands of kilometers) impacts and relatively short atmospheric lifetimes (days to a month). Historically, this has meant that EPA could identify and differentiate between affected and unaffected areas and devise control strategies appropriate for each area. Controls applied within an area with high concentrations of traditional air pollutants generally have been effective in achieving significant reductions in air pollution concentrations within that area in a relatively short amount of time. The spatial nature of traditional air pollution also has made it appropriate to place the primary responsibility for planning controls on state, tribal, or local governments.

In the years since the CAA was enacted, we have learned that some traditional air pollutants (e.g., ozone, particulates and their precursors) are transported across regions of the country and thus have geographically broader impacts than individual states can address on their own. Our control strategies for those pollutants have evolved accordingly. The Nitrogen Oxides (NOx) SIP Call Rule and the Clean Air Interstate Rule (CAIR) are examples of regional control programs that significantly supplement local control measures. NSPS and motor vehicle controls are examples of national measures that also help improve air quality locally and regionally.

The global nature and effect of GHG emissions raise questions regarding the suitability of CAA provisions that are designed to protect local and regional air quality by controlling local and regional emission sources.[54] As noted above, GHGs are relatively evenly distributed throughout the global atmosphere. As a result, the geographic location of emission sources and reductions are generally not important to mitigating global climate change. Instead, total GHG emissions in the U.S. and elsewhere in the world over time determine cumulative global GHG concentrations, which in turn determine the extent of climate change. As a result, it will be the total emission reductions achieved by the U.S. and the other countries of the world that will determine the extent of climate change mitigation. The global nature of GHGs suggests that the programmatic and analytical tools used to address local and regional pollutants under the CAA (e.g., SIPs, monitoring networks, and models) would need to be adapted to inventory, analyze, control effectively and evaluate progress in achieving GHG reductions.

[54] It should be noted that international transport of ozone and particulate matter precursors contributes to NAAQS nonattainment in some areas of the U.S. Nevertheless, most traditional air pollution problems are largely the result of local and regional emission sources, while for GHGs, worldwide emissions determine the extent of the problem.

EPA seeks information about how differences in pollutant characteristics should inform regulation of these pollutants under the CAA. EPA also requests comment on the types of effective programs at all levels (local, regional, national and international) that may be feasible to design and implement under existing CAA authorities.

E. Relationship to Other Environmental Media

An effective GHG control program may require application of many technologies and approaches that may in turn result in increased discharges to water, generation of solid materials that require appropriate disposal, or have other impacts to the environment that may not be addressed under the CAA. Examples of these impacts include the potential for groundwater contamination from geological sequestration of CO2, the generation of spent sorbent material from carbon capture systems, or the depletion of water resources and increased nutrient runoff into surface waters from increased production of bioenergy feedstocks. EPA and other regulatory agencies at the tribal, state, and local level may need to respond to such impacts to prevent or minimize their impact to the environment and public health under authorities other than the CAA.

Since the nature and extent of these impacts would depend upon the technologies and approaches that are implemented under a GHG control program, an important consideration in designing GHG controls is minimizing or mitigating such impacts EPA seeks comment on how different regulatory approaches to GHG control under the CAA could result in environmental impacts to water or land that could require response under the CAA or EPA's other legislative authorities.

F. Other Key Policy and Economic Considerations for Selecting Regulatory Approaches

This section identifies general policy considerations relevant to developing potential regulatory approaches for controlling GHG emissions. In developing approaches under the CAA, EPA must first consider the Act's provisions as well as the Agency's previous interpretation of the provisions and relevant and controlling court opinions. Provisions of the CAA vary in terms of the degree of flexibility afforded EPA in designing implementing regulations under the Act. To the extent particular provisions permit, EPA believes the following considerations should guide its choice among available regulatory approaches. This section also discusses three selected issues in greater depth because of their importance to designing effective GHG controls: advantages of market-oriented regulatory approaches, economy-wide and sector-based regulation under the CAA, and emissions leakage and international competitiveness. In discussing these and other policy and economic considerations, EPA is not directly or indirectly implying that it possesses the requisite statutory authority in all areas.

1. Overview of Policy and Economic Considerations

The following considerations are useful in developing potential regulatory approaches to the extent permissible under the CAA. These considerations are also generally applicable to the design of GHG control legislation. EPA is in the process of evaluating the CAA options described later in this notice in light of these considerations.

Effectiveness of health and environmental risk reduction: How much would the approach reduce negative health and environmental impacts (or the risk of such impacts), relative to other potential approaches?

Certainty and transparency of results: How do the potential regulatory approaches balance the trade-off between certainty of emission reductions and costs? To what extent can compliance flexibility be provided for regulated entities while maintaining adequate accountability for emission reductions?

Cost-effectiveness and economic efficiency considerations: To what extent does the approach allow for achieving health and environmental goals, determined in a broader policy process, in a manner that imposes the least cost? How do the societal benefits compare to the societal costs? To what extent are there non-monetizable or unquantifiable benefits and costs? Given the uncertainties associated with climate change, to what extent can economic efficiency be judged?

Equity considerations (i.e., distributional effects): Does the approach by itself or in combination with other programs result in a socially acceptable apportionment of the burden of emission reduction across groups in our society? Does the approach provide adequate protection for those who will experience the adverse effects of emissions, including future generations?

Policy flexibility over time: Does the approach allow for updating of environmental goals and mechanisms for meeting those goals as new information on the costs and benefits of GHG emission reductions becomes available?

Incentives for innovation and technology development: Does the approach provide incentives for development and deployment of new, cleaner technologies in the United States and transfer abroad? Does the approach create incentives for individual regulated entities to achieve greater-than-required emissions reductions?

Competitiveness/emissions shifts: Can the approach be designed to reduce potential adverse impacts and consequent shifts in production and emissions to other sectors or geographic areas? Can the policy be designed to minimize the shifting, or "leakage," of emissions to other sectors or other countries, which would offset emission reduction benefits of the policy? To what extent can the approach consider the degree and nature of action taken by other countries?

Administrative feasibility: How complex and resource-intensive would the approach be for federal, state, and local governments and for regulated entities? Do personnel in the public and private sectors have sufficient expertise, or can they build sufficient expertise, to successfully implement the approach?

Enforceability: Is the approach enforceable in practice? Do available regulatory options differ regarding whether the government or the regulated entity bears the burden of demonstrating compliance?

Unintended consequences: Does the approach result in unintended consequences or unintended effects for other regulations? Does the approach allow for consideration of, and provide tools to address, any perverse incentives?

Suitability of tool for the job: Overall, is the approach well-suited to the environmental problem, or the best-suited among imperfect alternatives? For example, does the regulatory approach fit the characteristics of the pollutant in question (e.g., the global and long-lived nature of GHGs, high volume of CO_2 emissions)?

2. Market-Oriented Regulatory Approaches for GHGs

EPA believes that market-oriented regulatory approaches, when well-suited to the environmental problem, offer important advantages over non-market-oriented approaches. A number of theoretical and empirical studies have shown these advantages.[55] In general, market-oriented approaches include ways of putting a price on emissions through a fixed price (e.g., a tax) or exchangeable quantity-based instrument (e.g., a cap-and-trade program), while non-market-oriented approaches set performance standards limiting the rate at which individual entities can emit, or prescribe what abatement behaviors or technologies they should use.[56] The primary regulatory advantage of a market-oriented approach is that it can achieve a particular emissions target at a lower social cost than a non-market-oriented[57] approach (Baumol and Oates, 1971; Tietenberg, 1973).[58] This is because market-oriented approaches leave the method

[55] See EPA (2000), Baumol and Oates (1988), Tietenberg (2006) and Burtraw et al. (2005) for a detailed description of the advantages of market-oriented policies, such as the Title IV sulfur dioxide trading program, over non-market-oriented approaches.

[56] Performance standards provide a source flexibility to use any emission reduction method that meets the performance standard; they can be coupled with market-oriented approaches such as emissions trading to promote lower costs and technology innovation, as described later in this section.

[57] Many studies use the term "command-and-control" to refer to non-market-oriented approaches. Here we use the term "non-marketed-oriented" because the term "command and control" may be misleading when used to refer to performance-based emission limits that allow the regulated entity to choose the control technology or strategy for compliance.

[58] It is important to note that judgments about the appropriate mitigation approach also may consider important societal values not fully captured in economic analysis, such as political, legal, and ethical considerations. For example, different regulatory forms may result in different distributions of costs and

for reducing pollution to the emitter, and emitters have an incentive to find the least cost way of achieving the regulatory requirement. Efficient market-oriented regulatory systems provide a common emissions price for all emitters that contribute to a particular harm, either through the tax on emissions or the price of an exchangeable right to emit. As a result, the total abatement required by the policy can theoretically be distributed across all emitters in such a way that the marginal cost of control is equal for all emitters and the cost of reducing emissions is minimized.[59] Non-market-oriented policies offer emitters fewer choices on how to reduce emissions, which can lead to higher costs than are necessary to achieve the overall environmental objective (i.e. emission level).

As noted previously, it is especially important that any GHG emission reduction policy encourage the innovation, development and diffusion of technologies to provide a steady decline in the costs of emission reductions. Another advantage of market-oriented approaches is that they generally provide a greater incentive to develop new ways to reduce pollution than non-market-oriented approaches (Malueg 1989; Milliman and Prince 1989; Jung et al., 1996). Polluters not only have an incentive to find the least cost way of adhering to a standard but they also have an incentive to continually reduce emissions beyond what is needed to comply with the standard. For every unit of emissions reduced under a market-oriented policy, the emitter either has a lower tax burden or can sell an emissions permit (or buy one less emissions permit). Also, there are more opportunities under a market-oriented approach for developers of new control technologies to work directly with polluters to find less expensive ways to reduce

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benefits across individuals and firms. This is a particularly sensitive issue with policies that raise energy costs, which are known to be regressive. However, these issues are not discussed at length here.

[59] For a standard textbook treatment supporting this finding see Tietenberg (2006) or Callan and Thomas (2007).

emissions, and polluters are faced with less compliance risk if a new pollution control technique does not work as expected. This is because they can either pay for their unanticipated emissions through the tax or by purchasing emission rights instead of being subject to enforcement action (Hahn, 1989).

There are a number of examples of CAA rules in which market-oriented approaches have been used for groups of mobile or stationary sources. Usually this has taken the form of emissions trading within a sector or subsector of a source category, although there are some examples of broader trading programs. Differences in implications of sector-specific and economy-wide market-oriented systems are discussed in subsection below.

The cost advantage of market-oriented policies can be extended when emitters are allowed to achieve a particular environmental objective across multiple pollutants that affect environment quality in the same way but differ in the magnitude of that effect (e.g., different GHGs have different global warming potentials). Either a cap-and-trade or a tax approach could be designed so that the effective price per unit of emissions is higher for those pollutants that have a greater detrimental effect. Under a cap, the quantity of emissions reductions is fixed but not the price; under a tax, the price is fixed but not the emissions reductions. Some current legislative proposals include flexible multiple-pollutant market-oriented policies for the control of GHG emissions.

Market-oriented approaches are relatively well-suited to controlling GHG emissions. Since emissions of the major GHGs are globally well-mixed, a unit of GHG emissions generally has the same effect on global climate regardless of where it occurs. Also, while policies can control the flow of GHG emissions, what is of ultimate concern is the concentration of cumulative GHGs in the atmosphere. Providing flexibility on the method, location and precise timing of GHG reduction would not significantly affect the global climate protection benefits of a GHG control program (assuming effective enforcement mechanisms), but could substantially reduce the cost and encourage technology innovation.[60] However, it should be noted that for GHG control strategies that also reduce emissions of traditional pollutants, the timing and location of those controls could significantly affect air quality in local or regional areas. There is the potential for positive air quality effects from strategies that reduce both GHGs and traditional pollutants, and for adverse air quality effects that may be avoidable through complementary measures to address air quality. For example, when the acid rain control program was instituted, existing sulfur dioxide control programs were left in place to ensure that trading under the acid rain program did not undermine achievement of local air quality objectives.

As noted previously, broad-based market-oriented approaches include emissions taxes and cap-and-trade programs with and without cost containment mechanisms. While economists disagree on which of these approaches – emissions taxes or cap-and-trade programs -- may be particularly well-suited to the task of mitigating GHG emissions, they do agree that attributes such as flexibility, cost control, and broad incentives for minimizing abatement costs and developing new technologies are important policy

[60] We say "precise" timing because the qualifier is important: the IPCC and others have noted that lower GHG stabilization targets would require steeper and earlier emission reductions, whereas stabilization targets that allow for more warming (with higher associated risks and impacts) would require less steep and later emission reductions.

design considerations.[61] For a description of various market-oriented approaches, see section VII.G.

3. Legal Authority for Market-Oriented Approaches under the Clean Air Act

The ability of each CAA regulatory authority potentially applicable to GHGs to support market-oriented regulatory approaches is discussed in sections VI and VII of this notice. To summarize, some CAA provisions permit or require market-oriented approaches, and others do not. Trading programs within sectors or subsectors have been successfully implemented for a variety of mobile and stationary source categories under the Act, including the Acid Rain Control Program (58 FR 3590 (Jan. 11, 1993)) and a variety of on-road and non-road vehicle and fuel rules. Multi-sector trading programs, though not economy-wide, have been successfully implemented under section 110(a)(2)(D) for nitrogen oxides (i.e. the NOx SIP Call Rule) and under Title VI for ozone-depleting substances, and may be possible among stationary source sectors under section 111. An economy-wide system might be legally possible under CAA section 615 (if the two-part test unique to that section were met) or if a NAAQS were established for GHGs. However, any economy-wide program under either provision would not stand alone; it would be accompanied by source-specific or sector-based requirements as a result of other CAA provisions (e.g., PSD permitting under section 165).

The CAA does not include a broad grant of authority for EPA to impose taxes, fees or other monetary charges specifically for GHGs and, therefore, additional

[61] These approaches also raise the issue of the potential use of revenues from collecting a tax or auctioning allowances to emit GHGs at levels that do not exceed the cap. See Chapter 4 of US EPA (2000), "Guidelines for Preparing Economic Analyses," EPA 240-R-00-003.

legislative authority may be required if EPA were to administer such charges (which we will refer to collectively as fees). EPA may promulgate regulations that impose fees only if the specific statutory provision at issue authorizes such fees, whether directly or through a grant of regulatory authority that is written broadly enough to encompass them. For example, CAA section 110(a)(2)(A) allows for the use of "economic incentives such as fees, marketable permits, and auctioning allowances." Under this provision, some states intend to auction allowances under CAIR (70 FR 25162 (May 12, 2005)) and some have under the NOx SIP Call Rule (63 FR 57356 (Oct. 27, 1998)). By the same token, states have authority to impose emissions fees as economic incentives as part of their SIPs and collect the revenues. Similarly, section 110(a)(2)(A) authorizes EPA to impose fees as economic incentives as part of a Federal Implementation Plan (FIP) under section 110(c), although EPA has never done so.[62]

Section 111 authorizes EPA to promulgate "standards of performance," which are defined as "standard[s] for emissions of air pollutants." EPA has taken the position that this term authorizes a cap-and-trade program under certain circumstances. A fee program differs from a cap and trade because it does not establish an overall emission limitation, and we have not taken a position on whether, given this limitation, a fee program fits the definition of a "standard of performance." Even so, under section 111 costs may be considered when establishing NSPS regulations, and a fee may balance the consideration of assuring emissions are reduced but not at an unacceptably high cost. Also, there may be advantages of including an emission fee feature into a cap-and-trade program (i.e. as a price ceiling). The use of a price ceiling that is not expected to be

[62] Any such revenues from a FIP would be deposited in the Federal Treasury under the Miscellaneous Receipts Act , and not retained and disbursed by EPA

triggered except in the case of unexpectedly high (or low) control costs may be viewed differently under the auspices of the CAA than a stand-alone emissions fee.

We request comment on what CAA provisions, if any, would authorize emissions fees to control GHG emissions, and whether there are other approaches that could be taken under the CAA that would approximate a fee. Furthermore, we request comments on the use of emission fee programs under other sections of the Act. We also seek comment on whether sector-specific programs, or inter-sector programs where emission fees on a CO_2 equivalent basis are harmonized, might be more appropriate as possible regulatory mechanisms under the Act.

4. Economy-Wide and Sector-Based Regulation in a Clean Air Act Context

Several legislative cap-and-trade proposals for reducing GHG emissions are designed to be nearly economy wide, meaning that they attempt to reduce GHG emissions in most economic sectors through a single regulatory system. By contrast, many CAA authorities are designed for regulations that apply to a sector, subsector or source category, although broader trading opportunities exist under some authorities. This section discusses the relative merits of economy-wide systems and sector-based market-oriented approaches. Theses considerations may also be relevant in considering the use of CAA provisions in tandem with any climate change legislation.

i. Economy-wide approach

Economic theory suggests that establishing a single price for GHG emissions across all emitters through an economy-wide, multiple GHG, market-oriented policy would promote optimal economic efficiency in pursuing GHG reductions. According to the economics literature, economy-wide GHG trading or GHG emissions taxes could offer significantly greater cost savings than a sector-by-sector approach for GHGs because the broader the universe of sources covered by a single market-oriented approach (within a sector, across sectors, and across regions), the greater the potential for finding lower-cost ways to achieve the emissions target. If sources of pollution are compartmentalized into different sector-specific or pollutant-specific approaches, including the relatively flexible cap-and-trade approaches, each class of polluter may still face a different price for their contribution to the environmental harm, and therefore some trading opportunities that reduce pollution control costs will be unrealized (Burtraw and Evans, 2008).[63] Taking a sector-by-sector approach to controlling GHG emissions is likely to result in higher costs to the economy. For example, limiting a market-oriented GHG policy to the electricity and transportation sectors could double the welfare cost of achieving a five percent reduction in carbon emissions compared to when the industrial sector is also included.[64]

A second factor that favors making the scope of a market-oriented system as broad as possible is that the incentive for development, deployment and diffusion of new technologies would be spread across the economy. In contrast to an approach targeting a few key sectors, an economy-wide approach would affect a greater number of diverse

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[63] With traditional pollutants there are geographic issues to consider.

[64] William Pizer, Dallas Burtraw, Winston Harrington, Richard Newell, and James Sanchirico (2006), "Modeling Economywide versus Sectoral Climate Policies Using Combined Aggregate-Sectoral Models," The Energy Journal, Vol. 27, No. 3: 135-168

GHG-emitting activities, and would influence a larger number of individual economic decisions, potentially leading to innovation in parts of the economy not addressed by a sector-by-sector approach.

As stated at the outset of this section, there are, first and most important, CAA authority issues as well as other policy and practical considerations in addition to economic efficiency that must be weighed in evaluating potential CAA approaches to GHG regulation. An economy-wide, market-oriented environmental regulation has never been implemented before in the U.S. The European Union, after encountering difficulties in early years of implementation, recently adopted major revisions to its broad multi-sector cap-and-trade system; this illustrates that some time and adjustments may be needed for such a program to achieve its intended effect. Although EPA has successfully designed and implement market-oriented systems of narrower scope, a single economy-side system would involve new design and implementation challenges, should the CAA make possible such a system. For example --

- Administrative costs may be a concern, because more sources and sectors would have to be subject to reporting and measurement, monitoring, and verification requirements.
- Some sources and sectors are more amenable to market-oriented approaches than others. The feasibility and cost of accurate monitoring and compliance assurance needed for trading programs (whether economy-wide or sector-based) varies among sectors and source size. As a result, there are potential tradeoffs between trading program scope and level of assurance that required emissions reductions will be achieved.

- To broaden the scope of cap-and-trade systems, covered sources could be allowed to purchase GHG emission reductions "offsets" from non-covered sources. However, offsets raise additional accountability issues, including how to balance cost efficiency against certainty of emissions reductions, how to quantify resulting emissions reductions, and how to ensure that the activities generating the offsets are conducted and maintained over time.
- Allocating allowances or auction revenues for an economy-wide GHG trading system would be very challenging for an executive branch agency because of high monetary stakes and divergent stakeholder views on how to distribute the allowances or revenues to promote various objectives. For example, many economists believe that auctioning allowances under a cap-and-trade system and using the proceeds to reduce taxes that distort economic incentives would be economically efficient, but regulated entities typically favor free allowance allocations to offset their compliance costs.[65], [66]

ii. Sector-based and multi-sector trading under the Clean Air Act

As mentioned above, EPA has implemented multi-sector, sector and subsector-based cap-and-trade approaches in a number of CAA programs, including the Acid Rain (SO_2) Program, the NOx SIP Call Rule, the Clean Air Interstate Rule (CAIR), and the stratospheric ozone-depleting substances (ODS) phase-out rule. In the case of the acid rain and ODS rules, the CAA itself called for federal controls. By contrast, the NOx SIP

[65] Many economists also suggest that an emissions tax with proceeds used to decrease distortionary taxes would be economically efficient; however, the CAA does not authorize such a program.

[66] Bovenberg and Goulder (2001) find that freely allocating 20% of allowances to fossil fuel suppliers is enough to keep profits from falling. When all allowances are freely allocated, profits are found to be *higher* than in the absence of the carbon cap-and-trade policy. Free allocation of allowances or an approach that exempts particular sectors also raises the specter of "rent-seeking," the notion that sectors or particular source categories will lobby to gain preferential treatment and, in essence, be subject to less regulatory oversight than other sectors or competitors.

Call rule and CAIR were established by EPA through regulations under CAA section 110(a)(2)(d) to help states attain various NAAQS. The two rules and EPA's accompanying model rules enable states to adopt compatible cap-and-trade programs that form regional interstate trading programs. The power sector and a few major industrial source categories are included in the trading system for the NOx SIP Call, and the trading system for CAIR focuses on the electricity generation sector.

In addition to creating cap-and-trade systems, EPA has often incorporated market-oriented emissions trading elements into the more traditional performance standard approach for mobile and stationary sources. Coupling market-oriented provisions with performance standards provides some of the cost advantages and market flexibility of market-oriented solutions while also directly incentivizing technology innovation within the particular sector, as discussed below. For example, performance standards for mobile sources under Title II have for many years been coupled with averaging, banking and trading provisions within a subsector. In general, averaging allows covered parties to meet their emissions obligation on a fleet- or unit-wide basis rather than requiring each vehicle or unit to directly comply. Banking provides direct incentives for additional reductions by giving credit for over-compliance; these credits can be used toward future compliance obligations and, as such, allow manufacturers to put technology improvements in place when they are ready for market, rather than being forced to adhere to a strict regulatory schedule that may or may not conform to industry or company developments. Allowing trading of excess emission reductions with other covered parties provides an incentive for reducing emissions beyond what is required.

Based on our experience with these programs, EPA believes that sector and multi-sector trading programs for GHGs – relative to non-market regulatory approaches – could offer substantial compliance flexibility, cost savings and incentives for innovation to regulated entities. In addition, as discussed below, in some sectors there may be a need to more directly incentivize technology development because of market barriers that a sector-specific program might help to overcome. To the extent sector-based approaches could provide for control of multiple pollutants (e.g., traditional pollutants and GHGs), they could provide additional cost savings relative to multiple single-pollutant, sector-based regulations. Another consideration is that it may be simpler and thus faster to move forward with cap-and-trade programs for sectors already involved in, and thus familiar with, cap-and-trade programs. This raises the question of whether it would make sense to phase in an economy-wide system over time.

Sector and multi-sector approaches would not offer the relative economic efficiency of the economy-wide model for the reasons explained above. To the extent the program sets more stringent requirements for new sources than for existing source, a sector or multi-sector approach could also pose the vintage issues discussed below. It is also important to keep in mind that the economic efficiency of any CAA cap-and-trade approach for GHGs, sector- or economy-wide, could be reduced to a significant extent by the application of other GHG control requirements (e.g., PSD permitting) to the sources covered by the cap-and-trade program, if the result were to restrict compliance options.

iii. Combining economy-wide and sector-based approaches

It is worth noting that market-oriented approaches may not incentivize the most cost-effective reductions when information problems, infrastructure issues, technological issues or other factors pose barriers that impeded the market response to price incentives. In such instances, there may be economic arguments for combining an economy-wide approach with complementary sector-based requirements unless these problems can be directly addressed, for instance by providing the information needed or directly subsidizing the creation of needed infrastructure.

For instance, given the relative inelasticity of demand for transportation, even a relative high permit price for carbon may not substantially change consumer vehicle purchases or travel demand, although recent reports indicate that the current price of gasoline and diesel are inducing an increasing number of consumers to choose more fuel efficient vehicles and drive less. Some have expressed concern that this relatively inelastic demand may be related to undervaluation by consumers of fuel economy when making vehicle purchasing decisions. If consumers adequately value fuel economy, fuel saving technologies will come online as a result of market forces. However, if consumers undervalue fuel economy, vehicle or engine manufacturers may need a more direct incentive for making improvements or the technology innovation potential may well be delayed or not fully realized. Beyond this consumer valuation issue, questions have been raised as to whether a carbon price alone (especially if the impact is initially to raise gasoline prices by pennies a gallon) will provide adequate incentives for vehicle manufacturers to invest now in breakthrough technologies with the capability to achieve significantly deeper emissions reductions in the future, and for fuel providers to make substantial investments in a new or enhanced delivery infrastructure for large-scale deployment of lower carbon fuels.[67]

EPA requests comment on how to balance the different policy and economic considerations involved in selecting potential regulatory approaches under the CAA, and on how the potential enactment of legislation should affect EPA's deliberations on how to use CAA authorities.

5. Other Selected Policy Design Issues

Another policy and legal issue in regulatory design is whether requirements should differentiate between new and existing sources. Because it is generally more costly to retrofit pollution control equipment than to incorporate it into the construction or manufacture of a new source, environmental regulations, including under the CAA, frequently apply stricter standards to new or refurbished sources than to "grandfathered" sources that pre-date the regulation. New sources achieve high-percentage reductions and over time existing high-emitting sources are replaced with much cleaner ones. For example, emissions from the U.S. auto fleet have been dramatically reduced over time through new vehicle standards. However, some suggest that stricter pollution control requirements for new or refurbished sources may retard replacement of older sources, discouraging technology investment, innovation and diffusion while encouraging older and less efficient sources to remain in operation longer, thereby reducing the environmental effectiveness and cost-effectiveness of the regulation. Others believe that

[67] See Kopp and Pizer, "Assessing U.S. Climate Policy Options," Chapter 12, RFF Press: Washington, DC (2007).

economic factors other than differences in new and existing source requirements (e.g., capital outlay, power prices and fuel costs) have the most impact on rate of return, and that differences in regulatory stringency generally do not drive business decisions on when to build new capacity.

A 2002 EPA report on new source review requirements found that NSR "appears to have little incremental impact on construction of new electricity generation," but also found that "there were credible examples of cases in which uncertainty over the [NSR] exemption for routine activities has resulted in delay or cancellation of projects [at existing plants]" that would have increased energy capacity, improved energy efficiency and reduced air pollution.[68] To the extent that a gap in new and existing source requirements affects business decisions, regulating existing as well as new sources can diminish or eliminate that gap. In the power sector, the gap has narrowed over time, in part as a result of CAA national and regional cap-and-trade systems that do not discriminate between new and existing facilities (i.e. both new and old power platns must hold allowances to cover their NOx and SO2 emissions). Another consideration is that equity issues can arise when applying retroactive requirements to existing sources. For GHGs, EPA requests comment on the concept of a market-oriented approach that does not differentiate between new and existing source controls and, by avoiding different marginal costs of control at new and existing sources, would promote more cost-effective emissions reductions. In addition, EPA requests comment on whether GHG regulations should differentiate between new and existing sources for various sectors, and whether there are circumstances in which requirements for stringent controls on new sources

[68] "New Source Review: Report to the President, June 2002," U.S. EPA, pp. 30-31.

would have policy benefits despite the existence of a cap-and-trade system that also would apply to those sources.

Another possible design consideration for a GHG program is whether and how lifecycle approaches to controlling GHG emissions could or should be used. Lifecycle (LC) analysis and requirements have been proposed for determining and regulating the entire stream of direct and indirect emissions attributable to a regulated source. Indirect emissions are emissions from the production, transportation, and processing of the inputs that go into producing that good. Section VI.D describes possible CAA approaches for reducing GHG emissions from transportation fuels through lifecycle analysis and includes a brief discussion of a potential lifecycle approach to reducing fuel-related GHG emissions. In that context, displacing petroleum-based fuels with renewable or alternative fuels can reduce fuel-related GHGs to the extent the renewable or alternative fuels are produced in ways that result in lower GHG emissions than the production of an equivalent amount of fossil-based fuels. Tailpipe GHG emissions typically do not vary significantly across conventional and alternative or renewable fuels.

EPA recognizes that other programs, such as stationary source or area source programs described in this notice, could potentially address at least some of the indirect GHG emissions from producing fuels. We note that the technology and fuel changes that may result from an economy-wide cap-and-trade approach would likely be different from the technology and fuel changes that may result from a lifecycle approach.

EPA asks for comment on how a lifecycle approach for fuels could be integrated other stationary source approaches and whether there are potentially overlapping incentives or disincentives. EPA also asks for comments on whether a lifecycle approach to reducing GHG emissions may be appropriate for other sectors and types of sources, and what the implications for regulating other sectors would be if a lifecycle approach is taken for fuels.

6. "Emissions Leakage" and International Competitiveness

A frequently raised concern with domestic GHG regulation unaccompanied by comparable policies abroad is that it might result in emissions leakage or adversely affect the international competitiveness of certain U.S. industries. The concern is that if domestic firms faced significantly higher costs due to regulation, and foreign firms remained unregulated, this could result in price changes that shift emissions, and possibly some production capacity, from the U.S. to other countries. Emissions leakage also could occur without being caused by a competitiveness issue: for instance, if a U.S. GHG policy raised the domestic price of petroleum-based fuels and led to reduced U.S. demand for those fuels, the resulting world price decline could spur increased use of petroleum-based fuels abroad, leading to increased GHG emissions abroad that offset U.S. reductions.

The extent to which international competitiveness is a potential concern varies substantially by sector. This issue is mainly raised for industries with high energy use and substantial potential foreign competition. Even for vulnerable sectors, the concern would depend on the actual extent which a program would raise costs for an energy intensive firm facing international competition, and on whether policies to address the competitiveness issue were adopted (either as part of the rule or in another venue).

Leakage also could occur within the U.S. if emissions in one sector or region are controlled, but other sources are not. In this case, the market effects could lead to increased activity in unregulated sectors or regions, offsetting some of the policy's emissions reductions. In turn, this would raise the cost of achieving the environmental objective. The more uniform the price signal for an additional unit reduction in GHG emissions across sectors, states, and countries, the less potential there is for leakage to occur.

A recent report has identified and evaluated five conceptual options for addressing competitiveness concerns in a legislative context; some options might also be available in a regulatory context.[69] The first option, weaker program targets, would affect the entire climate protection policy. Four other options also could somewhat decrease environmental stringency but would allow for the targeting of industries or sectors particularly vulnerable to adverse economic impacts:

- exemptions
- non-market regulations to avoid direct energy price increases on an energy-intensive industry
- distribution of free allowances to compensate adversely affected industries in a cap-and-trade system
- trade-related policies such as import tariffs on carbon or energy content, export subsidies, or requirements for importers to submit allowances to cover the carbon content of certain products.

[69] Morgenstern, Richard D., "Issue Brief 8: Addressing Competitiveness Concerns in the Context of a Mandatory Policy for Reducing U.S. Greenhouse Gas Emissions," in *Assessing U.S. Climate Policy Options: A report summarizing work at RFF [Resources for the Future] as part of the inter-industry U.S. Climate Policy Forum*, November 2007, Raymond J. Kopp and William A. Pizer, eds.

Significantly, the report noted that identifying the industries most likely to be adversely affected by domestic GHG regulation, and estimating the degree of impact, is complex in terms of data and analytical tools needed.

We request comment on the extent to which CAA authorities described in this notice could be used to minimize competitiveness concerns and leakage of emissions to other sectors or countries, and which approaches should be preferred.

G. Analytical Challenges for Economic Analysis of Potential Regulation

In the event that EPA pursues GHG emission reduction policies under the CAA or as a result of legislative action, we are required by Executive Order 12866 to analyze and take into account to the extent permitted by law the costs and benefits of the various policy options considered. Economic evaluation of GHG mitigation is particularly challenging due to the temporal and spatial dimensions of the problem discussed previously: GHG emissions have extremely long-run and global climate implications. Furthermore, changes to the domestic economy are likely to affect the global economy. In this section, we discuss a few overarching analytical challenges that follow from these points. Many of the issues discussed are also relevant when valuing changes in GHGs associated with non-climate policies.

1. Time Horizon and International Considerations in General

As discussed earlier in this section, changes in GHG emissions today will affect environmental, ecological, and economic conditions for decades to centuries into the future. In addition, changes in U.S. GHG emissions that result from U.S. domestic policy will affect climate change everywhere in the world, as will changes in the GHG emissions of other countries. U.S. domestic policy could trigger emissions changes across the U.S. economy and across regions globally, as production and competitiveness change among economic activities. Similarly, differences in the potential impacts of climate change across the world can also affect competitiveness and production. Capturing these effects requires long-run, global analysis in addition to traditional domestic and sub-national analyses.

2. Analysis of Benefits and Costs Over a Long Time Period

Since changes in emissions today will affect future generations in the U.S. and internationally, costs and benefits of GHG mitigation options need to be estimated over multiple generations. Typically, federal agencies discount future costs or benefits back to the present using a discount rate, where the discount rate represents how society trades-off current consumption for future consumption. With the benefits of GHG emissions reductions distributed over a very long time horizon, benefit and cost estimations are likely to be very sensitive to the discount rate. For policies that affect a single generation of people, the analytic approach used by EPA is to use discount rates of three and seven percent at a minimum.[70] According to the Office of Management and Budget (OMB), a three percent rate is consistent with what a typical consumer might expect in the way of a risk free market return (e.g., government bonds). A seven percent rate is an estimate of the average before-tax rate of return to private capital in the U.S. economy. A key challenge facing EPA is the appropriate discount rate over the longer timeframe relevant for GHGs.

There are reasons to consider even lower discount rates in discounting the costs of benefits of policy that affect climate change. First, changes in GHG emissions—both increases and reductions—are essentially long-run investments in changes in climate and the potential impacts from climate change. When considering climate change investments, they should be compared to similar alternative investments (via the discount rate). Investments in climate change are investments in infrastructure and technologies associated with mitigation; however, they yield returns in terms of avoided impacts over a period of one hundred years and longer. Furthermore, there is a potential for significant impacts from climate change, where the exact timing and magnitude of these impacts are unknown. These factors imply a highly uncertain investment environment that spans multiple generations.

When there are important benefits or costs that affect multiple generations of the population, EPA and OMB allow for low but positive discount rates (e.g., 0.5 – 3% noted by US EPA, 1 – 3% by OMB).[71] In this multi-generation context, the three percent discount rate is consistent with observed interest rates from long-term investments

[70] EPA (US Environmental Protection Agency), 2000. Guidelines for Preparing Economic Analyses. EPA 240-R-00-003. See also OMB (U.S. Office of Management and Budget), 2003. Circular A-4. September 17, 2003.

[71] OMB (2003). EPA (2000). These documents are the guidance used when preparing economic analyses for all EPA rulemakings.

available to current generations (net of risk premiums) as well as current estimates of the impacts of climate change that reflect potential impacts on consumers. In addition, rates of three percent or lower are consistent with long-run uncertainty in economic growth and interest rates, considerations of issues associated with the transfer of wealth between generations, and the risk of high impact climate damages. Given the uncertain environment, analysis could also consider evaluating uncertainty in the discount rate (e.g., Newell and Pizer, 2001, 2003).[72] EPA solicits comment on the considerations raised and discounting alternatives for handling both benefits and costs for this long term, inter-generational context.

3. Uncertainty in Benefits and Costs

The long time horizon over which benefits and costs of climate change policy would accrue and the global relationships they involve raise additional challenges for estimation. The exact benefits and costs of virtually every environmental regulation is at least somewhat uncertain, because estimating benefits and costs involves projections of future economic activity and the future effects and costs of reducing the environmental harm. In almost every case, some of the future effects and costs are not entirely known or able to be quantified or monetized. In the case of climate change, the uncertainly inherent in most economic analyses of environmental regulations is magnified by the long-term and global scale of the problem and the resulting uncertainties regarding socio-

[72] Newell, R. and W. Pizer, 2001. Discounting the benefits of climate change mitigation: How much do uncertain rates increase valuations? PEW Center on Global Climate Change, Washington, DC. Newell, R. and W. Pizer, 2003. Discounting the distant future: how much do uncertain rates increase valuations? Journal of Environmental Economics and Management 46: 52–71.

economic futures, corresponding GHG emissions, climate responses to emissions changes, the bio-physical and economic impacts associated with changes in climate, and the costs of reducing GHG emissions. For example, uncertainties about the amount of temperature rise for a given amount of GHG emissions and rates of economic and population growth over the next 50 or 100 years will result in a large range of estimates of potential benefits and costs. Lack of information with regard to some important benefit categories and the potential for large impacts as a result of climate exceeding known but uncertain thresholds compound this uncertainty. Likewise, there are uncertainties regarding the pace and form of future technological innovation and economic growth that affect estimates of both costs and benefits. These difficulties in predicting the future can be addressed to some extent by evaluating alternative scenarios. In uncertain situations such as that associated with climate, EPA typically recommends that analysis consider a range of benefit and cost estimates, and the potential implications of non-monetized and non-quantified benefits.

Given the substantial uncertainties in quantifying many aspects of climate change mitigation and impacts, it is difficult to apply economic efficiency criteria, or even positive net benefit criteria.[73] Identifying an efficient policy requires knowing the marginal benefit and marginal cost curves for GHG emissions reductions. If the marginal benefits are greater than the marginal costs, then additional emissions reductions are merited (i.e., they are efficient and provide a net benefit). However, the curves are not

[73] IPCC WGI. (2007). Climate Change 2007 - The Physical Science Basis Contribution of Working Group I to the Fourth Assessment Report of the IPCC, http://www.ipcc.ch/. IPCC WGII. (2007). Climate Change 2007 - Impacts, Adaptation and Vulnerability Contribution of Working Group II to the Fourth Assessment Report of the IPCC, http://www.ipcc.ch/. IPCC WGIII (2007). Climate Change 2007 – Mitigation Contribution of Working Group III to the Fourth Assessment Report of the IPCC, http://www.ipcc.ch/. US Congressional Budget Office (2005). Uncertainty in Analyzing Climate Change: Policy Implications. The Congress of the United States, January 2005.

precise lines; instead they are wide and partially unknown bands. Similarly, estimates of total benefits and costs can be expressed only as ranges. As a result, it is difficult to both identify the efficient policy and assess net benefits.

In situations with large uncertainties, the economic literature suggests a risk management framework as being appropriate for guiding policy (Manne and Richels, 1992; IPCC WGIII, 2007).[74] In this framework, the policymaker selects a target level of risk and seeks the lowest cost approach for reaching that goal. In addition, the decision-making process is an iterative one of acting, learning, and acting again (as opposed to there being a single decision point). In this context, the explicit or implicit value of changes in risk is important. Furthermore, some have expressed concern in the economics literature that standard deterministic approaches (i.e. approaches that imply there is only one known and single realization of the world) do not appropriately characterize the uncertainty and risk related to climate change and may lead to a substantial underestimation of the benefits from taking action (Weitzman, 2007a, 2007b).[75] Formal uncertainty analysis may be one approach for at least partially addressing this concern. EPA solicits comment on how to handle uncertainty in benefits and costs calculations and application, given the quantified and unquantified uncertainties.

4. Benefits Estimation Specific Issues – Scope, Estimates, State-of-the-art

[74] Manne, A. and R. Richels (1992). "Buying Greenhouse Insurance - the Economic Costs of Carbon Dioxide Emission Limits", MIT Press book, Cambridge, MA, 1992. IPCC WGIII (2007).
[75] Weitzman, M., 2007a, “The Stern Review of the Economics of Climate Change,” *Journal of Economic Literature*. Weitzman, M., 2007b, “Structural Uncertainty and the Statistical Life in the Economics of Catastrophic Climate Change,” Working paper http://econweb.fas.harvard.edu/faculty/weitzman/papers/ValStatLifeClimate.pdf.

Another important issue in economic analysis of climate change policies is valuing domestic and international benefits. U.S. GHG reductions are likely to yield both domestic and global benefits. Typically, because the benefits and costs of most environmental regulations are predominantly domestic, EPA focuses on benefits that accrue to the U.S. population when quantifying the impacts of domestic regulation. However, OMB's guidance for economic analysis of federal regulations specifically allows for consideration of international effects.[76]

GHGs are global pollutants. Economic principles suggest that the full costs to society of emissions should be considered in order to identify the policy that maximizes the net benefits to society, i.e., achieves an efficient outcome (Nordhaus, 2006).[77] Estimates of global benefits capture more of the full value to society than domestic estimates and can therefore help guide policies towards higher global net benefits for GHG reductions.[78] Furthermore, international effects of climate change may also affect domestic benefits directly and indirectly to the extent US citizens value international impacts (e.g., for tourism reasons, concerns for the existence of ecosystems, and/or concern for others); US international interests are affected (e.g., risks to U.S. national security, or the U.S. economy from potential disruptions in other nations); and/or domestic mitigation decisions affect the level of mitigation and emissions changes in general in other countries (i.e, the benefits realized in the U.S. will depend on emissions

[76] OMB (2003), page 15.
[77] Nordhaus, W., 2006, "Paul Samuelson and Global Public Goods," in M. Szenberg, L. Ramrattan, and A. Gottesman (eds), *Samuelsonian Economics*, Oxford.
[78] Both the United Kingdom and the European Commission following these economic principles in consideration of the global social cost of carbon (SCC) for valuing the benefits of GHG emission reductions in regulatory impact assessments and cost-benefit analyses (Watkiss et al, 2006).

changes in the U.S. and internationally). The economics literature also suggests that policies based on direct domestic benefits will result in little appreciable reduction in global GHGs (e.g., Nordhaus, 1995).[79]

These economic principles suggest that global benefits should also be considered when evaluating alternative GHG reduction policies.[80] In the literature, there are a variety of global marginal benefits estimates (see the Tol, 2005, and Tol, 2007, meta analyses).[81] A marginal benefit is the estimated monetary benefit for each additional unit of carbon dioxide emissions reduced in a particular year.[82]

Based on the characteristics of GHGs and the economic principles that follow, EPA developed ranges of global and U.S. *marginal* benefits estimates. The estimates were developed as part of the work evaluating potential GHG emission reductions from motor vehicles and their fuels under Executive Order 13432. However, it is important to note at the outset that the estimates are incomplete since current methods are only able to reflect a partial accounting of the climate change impacts identified by the IPCC

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[79] Nordhaus, William D. (1995). "Locational Competition and the Environment: Should Countries Harmonize Their Environmental Policies?" in Locational Competition in the World Economy, Symposium 1994, ed., Horst Siebert, J. C. B. Mohr (Paul Siebeck), Tuebingen, 1995.

[80] Recently, the National Highway Traffic Safety Administration (NHTSA) proposed a new rulemaking for average fuel economy standards for passenger cars and light trucks that is based on domestic *marginal* benefit estimates for carbon dioxide reductions. See section V.A.7.l.(iii) "Economic value of reductions in CO2 emissions" (p. 24413) of Vol. 73 of the Federal Registry. Department of Transportation, National Highway Traffic Safety Administration, 49 CFR Parts 523, 531, 533, 534, 536 and 537 [Docket No. NHTSA-2008 -0089], RIN 2127-AK29, Average Fuel Economy Standards: Passenger Cars and Light Trucks, Model Years 2011-2015, http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&o=0900006480541adc.

[81] Tol, Richard, 2005. The marginal damage costs of carbon dioxide emissions: an assessment of the uncertainties. *Energy Policy* 33: 2064–2074. Tol, Richard, 2007. The Social Cost of Carbon: Trends, Outliers and Catastrophes. *Economics Discussion Papers* Discussion Paper 2007-44, September 19, 2007. Tol (2007) has been published on-line with peer review comments (http://www.economics-ejournal.org/economics/discussionpapers/2007-44).

[82] This is sometimes referred to as the social cost of carbon, which specifically is defined as the net present value of the change in climate change impacts over the atmospheric life of the greenhouse gas and the resulting climate inertia associated with one additional net global metric ton of carbon emitted to the atmosphere at a particular point in time.

(discussed more below). Also, as noted above, domestic estimates omit potential impacts on the United States (e.g., economic or national security impacts) resulting from climate change impacts in other countries. The global estimates were developed from a survey analysis of the peer reviewed literature (i.e. meta analysis). U.S. estimates, and a consistent set of global estimates, were developed from a single model and are highly preliminary, under evaluation, and likely to be revised.

The range of estimates is wide due to the uncertainties described above relating to socio-economic futures, climate responsiveness, impacts modeling, as well as the choice of discount rate. For instance, for 2007 emission reductions and a 2% discount rate the global meta analysis estimates range from \$-3 to \$159/tCO_2, while the US estimates range from \$0 to \$16/tCO_2. For 2007 emission reductions and a 3% discount rate, the global meta-estimates range from \$-4 to \$106/tCO_2, and the US estimates range from \$0 to \$5/tCO_2.[83] The global meta analysis mean values for 2007 emission reductions are \$68 and \$40/tCO_2 for discount rates of 2% and 3% respectively (in 2006 real dollars) while the domestic mean value from a single model are \$4 and \$1/tCO_2 for the same discount rates. The estimates for future year emission changes will be higher as future marginal emissions increases are expected to produce larger incremental damages as physical and economic systems become more stressed as the magnitude of climate change increases.[84]

[83] See the Technical Support Document on Benefits of Reducing GHG Emissions for global estimates consistent with the U.S. estimates in the text and for a comparison to the Tol (2005) meta analysis peer reviewed estimates. Tol (2005) estimates were cited in NHTSA's proposed rule and by the 9th U.S. Circuit Court (Center for Biodiversity v. NHTSA, F. 3d. 9th Cir., Nov. 15, 2007).

[84] Note that, except for illustrative purposes, marginal benefits estimates in the peer reviewed literature do not use consumption discount rates as high as 7%.

The current state-of-the-art for estimating benefits is also important to consider when evaluating policies. There are significant partially unquantified and omitted impact categories not captured in the estimates provided above. The IPCC WGII (2007) concluded that current estimates are “very likely” to be underestimated because they do not include significant impacts that have yet to be monetized.[85] Current estimates do not capture many of the main reasons for concern about climate change, including non-market damages (e.g., species existence value and the value of having the option for future use), the effects of climate variability, risks of potential extreme weather (e.g., droughts, heavy rains and wind), socially contingent effects (such as violent conflict or humanitarian crisis), and potential long-term catastrophic events. Underestimation is even more likely when one considers that the current trajectory for GHG emissions is higher than typically modeled, which when combined with current regional population and income trajectories that are more asymmetric than typically modeled, imply greater climate change and vulnerability to climate change.

Finally, with projected increasing changes in climate, some types of potential climate change impacts may occur suddenly or begin to increase at a much faster rate, rather than increasing gradually or smoothly. In this case, there are likely to be jumps in the functioning of species and ecosystems, the frequency and intensity of extreme conditions (e.g., heavy rains, forest fires), and the occurrence of catastrophic events (e.g., collapse of the West Antarctic Ice Sheet). As a result, different approaches are necessary for quantifying the benefits of “small” (incremental) versus “large” (non-incremental) reductions in global GHGs. Marginal benefits estimates, like those presented above, can

[85] IPCC WGII, 2007. In the IPCC report, “very likely” was defined as a greater than 90% likelihood based on expert judgment.

be useful for estimating benefits for small changes in emissions. However, for large changes in emissions, a more comprehensive assessment of impacts would be needed to capture changes in economic and biophysical dynamics and feedbacks in response to the policy. Even small reductions in global GHG emissions are expected to reduce climate change risks, including catastrophic risks.

EPA solicits comment on the appropriateness of using U.S. and global values in quantifying the benefits of GHG reductions and the appropriate application of benefits estimates given the state of the art and overall uncertainties. We also seek comment on our estimates of the global and U.S. marginal benefits of GHG emissions reductions that EPA has developed, including the scientific and economic foundations, the methods employed in developing the estimates, the discount rates considered, current and proposed future consideration of uncertainty in the estimates, marginal benefits estimates for non-CO_2 GHG emissions reductions, and potential opportunities for improving the estimates. We are also interested in comments on methods for quantifying benefits for non-incremental reductions in global GHG emissions.

5. Energy security

In recent actions, both EPA and NHTSA have considered other benefits of a regulatory program that, though not directly environmental, can result from compliance with the program and may be quantified. [86] One of these potential benefits, related to the

[86] The EPA has worked with Oak Ridge National Laboratory to develop a methodology that quantifies energy security benefits associated with the reduction of imported oil. This methodology was used to support the EPA's 2007 Renewable Fuels Standards Rulemaking and NHTSA's 2008 proposed Average Fuel Economy Standards for Passenger Cars and Light Trucks Rulemaking for Model Years 2011 – 2015.

transportation sector, is increased energy security due to reduced oil imports. It is clear that both financial and strategic risks can result within the U.S. economy if there is a sudden disruption in the supply or a spike in the costs of petroleum. Conversely, actions that promote development of lower carbon fuels that can substitute for petroleum or technologies that more efficiently combust petroleum during operation can result in reduced U.S. oil imports, and can therefore reduce these financial and strategic risks. This reduction in risks is a measure of improved energy security and represents a benefit to the U.S. As the Agency evaluates potential actions to reduce GHGs from the U.S. economy, it intends to also consider the energy security impacts associated with these actions.

6. Interactions with Other Policies

Climate change and GHG mitigation policies will likely affect most biophysical and economic systems, and will therefore affect policies related to these systems. For example, as previously mentioned, climate change will affect air quality and GHG mitigation will affect criteria pollutant emissions. These effects will need to be evaluated, both in the context of economic costs and benefits, as well as policy design in order to exploit synergies and avoid inefficiencies across policies. Non-climate policies, whether focused on traditional air pollutants, energy, transportation, or other areas, can also affect baselines and mitigation opportunities for climate policies. For instance, energy policies can change baseline GHG emissions and the development path of particular energy technologies, potentially affecting the GHG mitigation objectives of climate policies as well as changing the relative costs of mitigation technologies. EPA seeks comment on important policy interactions.

7. Integrating Economic and Noneconomic Considerations

While economics can answer questions about the cost effectiveness and efficiency of policies, judgments about the appropriate mitigation policy, potential climate change impacts, and even the discount rate can be informed by economics and science but also involve important policy, legal, and ethical questions. The ultimate choice of a global climate stabilization target may be a policy choice that incorporates both economic and non-economic factors, while the choice of specific implementation strategies may be based on effectiveness criteria. Furthermore, other quantitative analyses are generally used to support the development of regulations. Distributional analyses, environmental justice analyses, and other analyses can be informative. For example, to the extent that climate change affects the distribution of wealth or the distribution of environmental damages, then climate change mitigation policies may have significant distributional impacts, which may in some cases be more important than overall efficiency or net benefits. EPA seeks comment on how to adequately inform economic choices, as well as the broader policy choices, associated with GHG mitigation policies.

IV. Clean Air Act Authorities and Programs

In developing a response to the Massachusetts decision, EPA conducted a thorough review of the CAA to identify and assess all of the Act's provisions that might be applied to GHG emissions. Although the Massachusetts decision addresses only CAA section 202(a)(1), which authorizes new motor vehicle emission standards, the Act contains a number of provisions that could conceivably be applied to GHGs emissions. EPA's review of these provisions and their interconnections indicated that a decision to regulate GHGs under section 202(a) or another CAA provision could or would lead to regulation under other CAA provisions. This section of the notice provides an overview of the CAA and examines the various interconnections among CAA provisions that could lead to broad regulation of GHG emission sources under the Act.

A. Overview of the Clean Air Act

The CAA provides broad authority to combat air pollution. Cars, trucks, construction equipment, airplanes, and ships, as well as a broad range of electric generation, industrial, commercial and other facilities, are subject to various CAA programs. Implementation of the Act over the past four decades has resulted in significant reductions in air pollution at the same time the nation's economy has grown.

As more fully examined in Section VII of this notice, the CAA provides three main pathways for regulating stationary sources of air pollutants. They include, in order of their appearance in the Act, national ambient air quality standards (NAAQS) and state plans for implementing those standards (SIPs); performance standards for new and existing stationary sources; and hazardous air pollutant standards for stationary sources. In addition, the Prevention of Significant Deterioration (PSD) program requires preconstruction permitting and emission controls for certain new and modified major stationary sources, and the Title V program requires operating permits for all major stationary sources.

Section 108 of the CAA authorizes EPA to list air pollutants that are emitted by many sources and that cause or contribute to air pollution problems such as ozone (smog) and particulate matter (soot). For every pollutant listed, EPA is required by section 109 to set NAAQS that are "requisite" to protect public health and welfare. EPA may not consider the costs of meeting the NAAQS in setting the standards. Under section 110, every state develops and implements plans for meeting the NAAQS by applying enforceable emission control measures to sources within the state. The Act's requirements for SIPs are more detailed and stringent for areas not meeting the standards (nonattainment areas) than for areas meeting the standards (attainment areas). Costs may be considered in implementing the standards. States are aided in their efforts to meet the NAAQS by federal emissions standards for mobile sources and major categories of stationary sources issued under other sections of the Act.

Under CAA section 111, EPA establishes emissions performance standards for new stationary sources and modifications of existing sources for categories of sources that contribute significantly to harmful air pollution. These new source performance standards (NSPS) reduce emissions of air pollutants addressed by NAAQS, but can be issued regardless of whether there is a NAAQS for the pollutants being regulated. NSPS requirements for new sources help ensure that when large sources of air pollutants are built or modified, they apply available emission control technologies and strategies.

When EPA establishes a NSPS for a pollutant, section 111(d) calls upon states to issue a standard for existing sources in the regulated source category except in two circumstances. First, section 111(d) prohibits regulation of a NAAQS pollutant. Second, "where a source category is being regulated under section 112, a section 111(d) standard of performance cannot be established to address any HAP listed under section 112(b) that may be emitted from that particular source category."[87] In effect, existing source NSPS provides a "regulatory safety net" for pollutants not otherwise subject to major regulatory programs under the CAA. Section 111 provides EPA and states with significant discretion concerning the sources to be regulated and the stringency of the standards, and allows consideration of costs in setting NSPS.

CAA section 112 provides EPA with authority to list and issue national emissions standards for hazardous air pollutants (HAPs) from stationary sources. HAPs are broadly defined as pollutants that present, or may present, a threat of adverse human or environmental effects. HAPs include substances which are, or may reasonably be anticipated to be, carcinogenic, mutagenic, neurotoxic or acutely or chronically toxic. Section 112 contains low emissions thresholds for regulation in view of its focus on toxic pollutants, and requires regulation of all major sources of HAPs. Section 112 also provides for "maximum achievable control technology" (MACT) standards for major sources, limiting consideration of cost.

The PSD program under Part C of Title I of the Act is triggered by regulation of a pollutant under any other section of the Act except for sections 112 and 211(o). As mentioned previously in this notice, under this program, new major stationary sources and modifications at existing major stationary sources undergo a preconstruction permitting process and install best available control technology (BACT) for each regulated pollutant. These basic requirements apply regardless of whether a NAAQS

[87] See 70 FR 15994, 16029-32 (Mar. 29, 2005).

exists for the pollutant; additional PSD requirements apply in the event of a NAAQS. The PSD program's control requirements help prevent large new and modified sources of air pollutants from significantly degrading the air quality in clean air areas. A similar program, called "new source review," ensures that new or modified large sources in areas not meeting the NAAQS do not make it more difficult for the areas to eventually attain the air quality standards.

Title II of the CAA provides comprehensive authority for regulating mobile sources of air pollutants. As more fully described in Section VI of this notice, Title II authorizes EPA to address all categories of mobile sources and take an integrated approach to regulation by considering the unique aspects of each category, including passenger vehicles, trucks and nonroad vehicles, as well as the fuels that power them. Title II requires EPA to consider technological feasibility, costs, safety and other factors in setting standards, and gives EPA discretion to set technology-forcing standards as appropriate. In addition, section 211(o) of the Act establishes the renewable fuel standard (RFS) program, which was recently strengthened by EISA to require substantial increases in the use of renewable fuels, including renewable fuels with significantly lower lifecycle GHG emissions than the fossil fuel-based fuels they replace.[88] The CAA's mobile source authorities work in tandem with the Act's stationary source authorities to help protect public health and the environment from air pollution.

Title VI of the CAA authorizes EPA to take various actions to protect stratospheric ozone, a layer of ozone high in the atmosphere that helps protect the Earth from harmful UVB radiation. As discussed in Section VIII of this notice, section 615

[88] As explained further below, EISA provides that regulation of renewable fuels based on lifecycle GHG emissions does not trigger any other regulation of GHGs under the CAA.

provides broad authority to regulate any substance, practice, process or activity that may reasonably be anticipated to affect the stratosphere and that effect may reasonably be anticipated to endanger public health or welfare.

B. Interconnections among Clean Air Act Provisions

The provisions of the CAA are interconnected in multiple ways such that a decision to regulate one source category of GHGs could or would lead to regulation of other source categories of GHGs. As described in detail below, there are several provisions in the CAA that contain similar endangerment language. An endangerment finding for GHGs under one provision of the Act could thus have ramifications under other provisions of the Act. In addition, CAA standards applicable to GHGs for one category of sources could trigger PSD requirements for other categories of sources that emit GHGs. How a term is interpreted for one part of the Act could also affect other provisions using the same term.

These CAA interconnections are by design. As described above, the Act combats air pollutants in several ways that reflect the nature and effects of the particular air pollutant being addressed. The Act's approaches are in many cases complementary and reinforcing, ensuring that air pollutants emitted by various types of emission sources are reduced in a manner and to an extent that reflects the relative contribution of particular categories of sources. The CAA's authorities are intended to work together to achieve air quality that protects public health and welfare.

For GHGs, the CAA's interconnections mean that careful attention needs to be paid to the consequences and specifics of decisions regarding endangerment and regulation of any particular category of GHG sources under the Act. In the case of traditional air pollutants, EPA and States have generally regulated pollutants incrementally over time, adding source categories or program elements as evolving circumstances make appropriate. In light of the broad variety and large number of GHG sources, any decision to regulate under the Act could lead, relatively quickly, to more comprehensive regulation of GHG sources under the Act. A key issue to consider in examining the Act's provisions and their interconnections is the extent to which EPA may choose among and/or tailor the CAA's authorities to implement a regulatory program that makes sense for GHGs, given the unique challenges and opportunities that regulating them would present.

This section of the notice explores these interconnections, and later sections explain how each CAA provision might apply to GHGs.

1. Similar Endangerment Language Is Found in Numerous Sections of the Clean Air Act.

The Supreme Court's decision in Massachusetts v. EPA requires EPA to address whether GHG emissions from new motor vehicles meet the endangerment test of CAA section 202(a)(1). That section states:

> *[t]he Administrator shall by regulation prescribe (and from time to time revise) . . . standards applicable to the emissions of any air pollutant from any class or*

> *classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.*

CAA section 202(a)(1). If the Administrator makes a positive endangerment determination for GHG emissions from new motor vehicles, he must regulate those GHG emissions under section 202(a) of the Act.

Similar endangerment language is found in numerous sections of the CAA, including sections 108, 111, 112, 115, 211, 213, 231 and 615. For example, CAA section 108(a)(1) (regarding listing pollutants to be regulated by NAAQS) states, "[T]he Administrator shall . . . publish, and shall from time to time thereafter revise, a list which includes each air pollutant (A) emissions of which, in his judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare . . . " CAA section 111(b)(1)(A) (regarding listing source categories to be regulated by NSPS) states: "[The Administrator] shall include a category of sources in such list if in his judgment it causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare." [89]

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[89] Other CAA endangerment provisions read as follows:
CAA section 115 (regarding international air pollution) states: *"Whenever the Administrator, upon receipt of reports, surveys or studies from any duly constituted international agency has reason to believe that any air pollutant or pollutants emitted in the United States cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare in a foreign country or whenever the Secretary of State requests him to do so with respect to such pollution which the Secretary of State alleges is of such a nature, the Administrator shall give formal notification thereof to the Governor of the State in which such emissions originate."*

CAA section 211(c)(1) (regarding regulating fuels and fuel additives) states: *"The Administrator may, . . . [regulate fuels or fuel additives] (A) if in the judgment of the Administrator any emission product of such fuel or fuel additive causes, or contributes, to air pollution which may reasonably be anticipated to endanger public health or welfare, (B) . . ."*

CAA section 213(a)(4) (regarding regulating nonroad engines) states: *"If the Administrator determines that any emissions not referred to in paragraph 2 [regarding CO, NOx and VOC emissions] from new*

While no two endangerment tests are precisely the same, they generally call on the Administrator of EPA to exercise his or her judgment regarding whether a particular air pollutant or source category causes or contributes to air pollution which may reasonably be anticipated to endanger public health or welfare. For provisions containing endangerment language, a positive finding of endangerment is a prerequisite for regulation under that provision.[90] The precise effect of a positive or negative finding depends on the specific terms of the provision under which it is made. For some provisions, a positive endangerment finding triggers an obligation to regulate (e.g., section 202(a)(1)), while for other provisions, a positive finding allows the Agency to regulate in its discretion (e.g., section 213). In some cases, other criteria must also be met to authorize or require regulation (e.g., section 108). Each of these sections is discussed in more detail later in this notice.

2. Potential Impact cross the Clean Air Act from a Positive or Negative Endangerment Finding or Regulation of GHGs under the Act

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nonroad engines or vehicles significantly contribute to air pollution which may reasonably be anticipated to endanger public health or welfare, the Administrator may promulgate . . . standards applicable to emissions from those classes or categories of new nonroad engines and new nonroad vehicles (other than locomotives) which in the Administrator's judgment cause, or contribute to, such air pollution, . . .".

CAA section 231 (regarding setting aircraft standards) states: *"The Administrator shall . . . issue proposed emissions standards applicable to the emission of any air pollutant from any class or classes of aircraft engines which in his judgment causes, or contributes to, air pollution which may reasonably be anticipated to endanger public health or welfare."*

CAA section 615 (regarding protection of stratospheric ozone) states: *"If, in the Administrator's judgment, any substance, practice, process, or activity may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, and such effect may reasonably be anticipated to endanger public health or welfare, the Administrator shall promptly promulgate regulations respecting the control of such substance, practice, process, or activity . . ."*

[90] As defined by the CAA, "air pollutant" includes virtually any substance or material emitted into the ambient air. Given the breadth of that term, many CAA provisions require the Administrator to determine whether a particular air pollutant causes or contributes to an air pollution problem as a prerequisite to regulating emissions of that pollutant.

a. Potential Impact on Sections Containing Similar Endangerment Language

One important issue is whether a positive or negative endangerment finding under one section of the CAA (e.g., under section 202(a) in response to the ICTA petition remand) would necessarily or automatically lead to similar findings under other provisions of the Act containing similar language. Even though CAA endangerment tests vary to some extent, an endangerment finding under one provision could have some bearing on whether endangerment could or should be found under other CAA provisions, depending on their terms and the facts at issue. EPA request comment on the extent to which an endangerment finding under any section of the CAA would lead EPA to make a similar endangerment finding under another provision.

In discussing the implications of making a positive endangerment finding under any CAA section, we use the actual elements of the endangerment test in section 202(a) for new motor vehicles as an example. The section 202(a) endangerment test asks two distinct questions –

(1) whether the ***air pollution at issue may reasonably be anticipated to endanger public health or welfare***, and

(2) whether ***emissions from new motor vehicles cause or contribute*** to that air pollution.

The first question is generic and looks at whether the type of air pollution at issue endangers public health or welfare. The second question is specific to motor vehicles, and considers the contribution of motor vehicle emissions to the particular air pollution problem. EPA must answer both questions in the affirmative for the Agency to regulate under section 202(a) of the Act.

A finding of endangerment under one section of the Act would not by itself constitute a complete finding of endangerment under any other section of the CAA. How much of a precedent an endangerment finding under one CAA provision would be for other CAA provisions would depend on the basis for the finding, the statutory tests for making findings, and the facts. For example, the two-part endangerment test in section 202(a) (motor vehicles) is similar to that in sections 211(c)(1) (highway and nonroad fuels) and 231(a)(2) (aircraft). An affirmative finding under section 202(a) on the first part of the test -- whether the air pollution at issue endangers public health or welfare -- would appear to satisfy the first part of the test for the other two provisions as well. However, an affirmative finding on the second part of the test, regarding the contribution of the particular source category to that air pollution, would not satisfy the test for the other provisions, which apply to different source categories. Still, a finding that a particular source category's emissions cause or contribute to the air pollution problem would likely establish some precedent for what constitutes a sufficient contribution for purposes of making a positive endangerment finding for other source categories.

Other similarities and differences among endangerment tests are also relevant. While the first part of the test in sections 213(a)(4) (nonroad engines and vehicles) and 111(b) (NSPS) is similar to that in other sections (i.e., whether the air pollution at issue endangers public health or welfare), the second part of the test in sections 213(a)(4) and 111(b) requires a finding of "significant" contribution. In addition, the test under section

111(b) applies to source categories, not to a particular air pollutant.[91] Sections 112 and 615 have somewhat different tests.

The extent to which an endangerment finding would set precedent would also depend on the pollutants at issue. For example, the ICTA petition to regulate motor vehicles under section 202(a) addresses CO_2, CH_4, N_2O, and HFCs, while the petitions to regulate GHGs from other mobile source categories collectively address water vapor, NOx and black carbon, as well as CO_2, CH_4, and N_2O. As further discussed below, the differences in the GHGs emitted by different types of sources may be relevant to the issue of how to define "air pollutant" for purposes of applying the endangerment tests.

In addition, some CAA sections require EPA to act following a positive endangerment finding, while others do not. In the case of section 202(a)(1), if we make a positive endangerment finding, we are required to issue standards applicable to motor vehicle emissions of the GHGs covered by the finding. Section 231(a) (aircraft) uses similar mandatory language, while sections 211(c)(1) (highway and nonroad fuel) and 213(a)(4) (nonroad engines and vehicles) authorize but do not require the issuance of regulations. Section 108 (NAAQS pollutants) requires that EPA list a pollutant under that section if a positive endangerment finding is made and two other criteria are met.

In sum, a positive or negative endangerment finding for GHG emissions under one provision of the Act could have a significant and direct impact on decisions under other CAA sections containing similar endangerment language. EPA requests comment on the interconnections between the CAA endangerment tests and the impact that a finding under one provision of the Act would have for other CAA provisions.

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[91] As discussed below, EPA has already listed a very wide variety of source categories under section 111(b)(1)(A).

b. Potential Impact on PSD Program

Another important issue is the potential for a decision to regulate GHGs for mobile or stationary sources to automatically trigger additional permitting requirements for stationary sources under the PSD program. As explained previously and in detail in Section VII of this notice, the main element of the PSD program under Part C of Title I of the Act is the requirement that a PSD permit be obtained prior to construction of any new major source or any major modification at an existing major source. Such a permit must contain emissions limitations based on BACT for each pollutant subject to regulation under the Act. EPA does not interpret the PSD program provisions to apply to GHG at this time, but any requirement to control CO_2 or other GHGs promulgated by EPA under other provisions of the CAA would make parts of the PSD program applicable to any additional air pollutant(s) that EPA regulates in this manner.

The PSD program applies to each air pollutant (other than a HAP) that is "subject to regulation under the Act" within the meaning of sections 165(a)(4) and 169(3) of the Clean Air Act and EPA's regulations.[92] As a practical matter, the identification of pollutants subject to the PSD program is driven by the BACT requirement because this requirement applies to the broadest range of pollutants. Under EPA's PSD program regulations, BACT is required for "each regulated NSR pollutant." 40 C.F.R. § 52.21(j)(2)-(3). EPA has defined this term to include pollutants that are regulated under a NAAQS or NSPS, a class I or II substance under Title VI of the Act, or "[a]ny pollutant

[92] Section 112(b)(6) precludes listed HAPs from the PSD program. Section 210(b) of EISA provides that nothing in section 211(o) of the Act, or regulations issued pursuant to that subsection, "shall affect or be construed to affect the regulatory status of carbon dioxide or any other greenhouse gas, or to expand or limit regulatory authority regarding carbon dioxide or any other greenhouse gas, for purposes of other provisions (including section 165) of this Act."

otherwise subject to regulation under the Act." *See* 52.21(b)(50).[93] Similarly, the determination of whether a source is a major source subject to PSD is based on whether the source emits more than 100 or 250 tons per year (depending on the type of source) of one or more regulated pollutants.[94]

EPA has historically interpreted the phrase "subject to regulation under the Act" to describe air pollutants subject to CAA statutory provisions or regulations that require actual control of emissions of that pollutant.[95] PSD permits have not been required to contain BACT emissions limit for GHGs because GHGs (and CO_2 in particular) have not been subject to any CAA provisions or EPA regulations issued under the Act that require actual control of emissions.[96] Although CAA section 211(o) now targets GHG emissions, EISA provides that neither it nor implementing regulations affect the regulatory status of GHGs under the CAA. In the absence of statutory or regulatory

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[93] This definition reflects EPA's interpretation of the phrase "each pollutant subject to regulation under the Act" that is used in the provisions in the Clean Air Act that establish the BACT requirement. Since this statutory language (as implemented in the definition of "regulated NSR pollutant") can apply to additional pollutants that are not also subject to a NAAQS, the scope of the BACT requirement determines the overall range of pollutants that are subject to the PSD permitting program.

[94] Under the relevant regulations, a major stationary source is determined by its emissions of "any regulated NSR pollutant." *See* 40 CFR section 52.21(b)(1)(i). Thus, the emissions that are considered in identifying a major source are determined on the basis of the same definition that controls the applicability of the BACT.

[95] 43 FR 26388, 26397 (June 19, 1978); Gerald E. Emison, Director, Office of Air Quality Planning and Standards, *Implementation of North County Resource Recovery PSD Remand* (Sept. 22, 1987) (footnote on the first page).

[96] See briefs filed before the Environmental Appeal Board on behalf of specific EPA offices in challenges to the PSD permits for Deseret Power Electric Cooperative (PSD Appeal No. 07-03) and Christian County Generation LLC (PSD Appeal No. 07-01), as well as the Response to Public Comments on Draft Air Pollution Control Prevention of Significant Deterioration (PSD) Permit to Construct [for Deseret Power Electric Cooperative], Permit No. PSD-OU-0002-04.00 (August 30, 2007), at 5-6, *available at* http://www.epa.gov/region8/air/permitting/deseret.html. EPA has not previously interpreted the BACT requirement to apply to air pollutants that are only subject to requirements to monitor and report emissions. *See*, 67 FR 80186, 80240 (Dec. 31, 2002); 61FR 38250, 38310 (July 31, 1996); *In Re Kawaihae Cogeneration Project* 7 E.A.D. 107, 132 (EAB 1997); *Inter-power of New York*, 5 E.A.D. 130, 151 (EAB 1994); Memorandum from Jonathan Z. Cannon, General Counsel to Carol M. Browner, Administrator, entitled *EPA's Authority to Regulate Pollutants Emitted by Electric Power Generation Sources* (April 10, 1998) (emphasis added); Memorandum from Lydia N. Wegman, Deputy Director, Office of Air Quality Planning and Standards, entitled *Definition of Regulated Air Pollutant for Purposes of Title V*, at 5 (April 26, 1993).

requirements to control GHG emissions under the Act, a stationary source need not consider those emissions when determining its major source status.

The Supreme Court's conclusion that GHGs are "air pollutants" under the CAA did not automatically make these pollutants subject to the PSD program. A substance may be an "air pollutant" under the Act without being regulated under the Act. The Supreme Court directed the EPA Administrator to determine whether GHG emissions from motor vehicles meet the endangerment test of CAA section 202(a). A positive finding of endangerment would require the Administrator to then set standards applicable to GHG emissions from motor vehicles under the Act. The positive finding itself would not constitute a regulation requiring actual control of emissions. GHGs would become regulated pollutants under the Act if and when EPA subjects GHGs to control requirements under a CAA provision other than sections 112 and 211(o).

c. Definition of "Air Pollutant"

Another way in which a decision to regulate GHGs under one section of the Act could impact other sections of the Act involves how the term "air pollutant" is defined as part of the endangerment analysis. As described above, many of the Act's endangerment tests require a two-part analysis: whether the *air pollution* at issue may reasonably be anticipated to endanger public health or welfare, and whether emissions of particular *air pollutants* cause or contribute to that air pollution. As discussed in more detail in the following sections, what GHGs might be defined as an "air pollutant" and whether those

GHGs are treated individually or as a group could impact EPA's flexibility to define the GHGs as air pollutants elsewhere in the CAA.

For example, as noted above, how EPA defines GHGs as air pollutants in making any positive endangerment finding could carry over into implementation of the PSD program. If EPA defines each individual GHG as a separate air pollutant in making a positive endangerment finding, then each GHG would be considered individually as a "regulated NSR pollutant" in the PSD program. On the other hand, if EPA defines the group of GHGs as an air pollutant, then the PSD program would need to treat the GHGs in the same manner – as a group. As discussed in more detail below, there are flexibilities and considerations under various approaches. One question is whether we could or should define GHGs as an "air pollutant" one way under one section of the Act (e.g., section 202) and another way under another section (e.g., section 231). *See, e.g.*, Environmental Defense v. Duke Energy Corp., 127 S.Ct. 1423, 1432 (2007) (explaining that the general presumption that the same term has the same meaning is not rigid and readily gives way to context). Another question is whether having different definitions of "air pollutant" would result in both definitions applying to the PSD program, and whether that result would mean that any flexibilities gained under one definition would be lost with the application of the second.

Another consideration, noted above, is that different source categories emit different GHGs. This fact could impact the definition of "air pollutant" more broadly. EPA requests comment on the issues raised in this section, to assist the Agency as it considers the implications of how to define a GHG "air pollutant" for the first time under any section of the Act.

2. Relationships among Various Stationary Source Programs

As a result of other interactions among various CAA sections, a decision to act under one part of the CAA may preclude action under another part of the Act. These interactions reflect the Act's different regulatory treatment of pollutants meeting different criteria, and prevent duplicative regulation. For instance, listing a pollutant under section 108(a), which leads to setting a NAAQS and developing SIPs for the pollutant, generally precludes listing the same air pollutant as a HAP under section 112(b), which leads to every major source of a listed HAP having to comply with MACT standards for the HAP. CAA section 112(b)(2).[97] Listing an air pollutant under section 108(a) also preludes regulation of that air pollutant from existing sources under section 111(d), which is intended to provide for regulation of air pollutants not otherwise subject to the major regulatory programs under the Act. CAA section 111(d)(1)(A).

Similarly, regulation of a substance under Title VI precludes listing that substance as a HAP under section 112(b) based solely on the adverse effects on the environment of that air pollutant. CAA section 112(b)(2). Moreover, listing an air pollutant as a HAP under section 112(b) generally precludes regulation of that air pollutant from existing sources under section 111(d). CAA section 111(d)(1)(A).[98] Finally, section 112(b)(6) provides that the provisions of the PSD program "shall not apply to pollutants listed under [section 112]." CAA section 112(b)(6), 42 U.S.C. 7412(b)(6)

[97] "No air pollutant which is listed under section 108(a) may be added to the list under this section, except that the prohibition of this sentence shall not apply to any pollutant which independently meets the listing criteria of this paragraph and is a precursor to a pollutant which is listed under section 108(a) or to any pollutant which is in a class of pollutants listed under such section."

[98] However, see 70 FR 15994, 16029-32 (2005) (explaining EPA's interpretation of the conflicting amendments to section 111(d) regarding HAPs).

V. Endangerment Analysis and Issues

In this section, we present our work to date on an endangerment analysis in response to the Supreme Court's decision in Massachusetts v. EPA. As explained previously, the Supreme Court remanded EPA's denial of the ICTA petition and ruled that EPA must either decide whether GHG emissions from new motor vehicles cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare, or explain why scientific uncertainty is so profound that it prevents making a reasoned judgment on such a determination.

In response to the remand, EPA analyzed synthesis reports and studies on how elevated concentrations of GHGs in the atmosphere, and other factors, contribute to climate change, and how climate change is affecting, and may affect in the future, human health and welfare, primarily within the United States. We also analyzed direct GHG effects on human health and welfare, i.e., those effects from elevated concentrations of GHGs that do not occur via climate change. This information, summarized briefly below, is contained in the Endangerment Technical Support Document found in the docket for today's notice. In addition, we compiled information concerning motor vehicle GHG emissions to assess whether motor vehicles cause or contribute to elevated concentrations of GHGs in the atmosphere. Information on motor vehicle emissions is contained in the Section 202 Technical Support Document, also found in the docket.

As discussed above, making an endangerment finding under one section of the CAA has implications for other sections of the Act. In this ANPR, we consider, and seek comment on these implications and other questions relevant to making an endangerment finding regarding GHG emissions.

This section is organized as follows. Section A discusses the legal framework for the endangerment analysis. Section B provides information on how “air pollution” could be defined for purposes of the endangerment analysis, as well as a summary of the science regarding GHGs and climate change and their effects on health and welfare. Section C uses the information on emissions of GHGs from the mobile source categories relevant to the ICTA Petition to frame a discussion about whether GHGs as “air pollutants” “cause or contribute” to “air pollution” which may reasonably be anticipated to endanger public health or welfare.

A. Legal Framework

The endangerment language relevant to the ICTA petition is contained in section 202(a) of the CAA. As explained previously, it is similar to endangerment language in many other provisions of the Act and establishes a two-part test. First, the Administrator must decide if, in his judgment, air pollution may reasonably be anticipated to endanger public health or welfare. Second, the Administrator must decide whether, in his judgment, emissions of any air pollutant from new motor vehicles or engines cause or contribute to this air pollution.

1. Origin of Current Endangerment and Cause or Contribute Language

The endangerment language in section 202(a) and other provisions of the CAA share a common legislative history that sheds light on the meaning of this language. As part of the 1977 amendments to the CAA, Congress added or revised endangerment language in various sections of the Act. The legislative history of those amendments, particularly the report by the House Committee on Interstate and Foreign Commerce, provides important information regarding Congress' intent when it revised this language. *See* H.R. Rep. 95-294 (1977), *as reprinted in* 4 A Legislative History of the Clean Air Act Amendments of 1977 at 2465 (hereinafter "LH").

a. Ethyl Corp. v. EPA

In revising the endangerment language, Congress relied heavily on the approach discussed in a federal appeals court opinion interpreting the pre-1977 version of CAA section 211. In Ethyl Corp v. EPA, 541 F.2d 1 (D.C. Cir. 1976), the en banc (i.e. full) court reversed a 3-judge panel decision regarding an EPA rule restricting the content of lead in leaded gasoline.[99] The en banc court began its opinion by stating:

> Man's ability to alter his environment has developed far more rapidly than his ability to foresee with certainty the effects of his alterations.

[99] At the time of the 1973 rules requiring the reduction of lead in gasoline, section 211(c)(1)(A) of the CAA stated that the Administrator may promulgate regulations that

> control or prohibit the manufacture, introduction into commerce, offering for sale, or sale of any fuel or fuel additive for use in a motor vehicle o motor vehicle engine (A) if any emissions product of such fuel or fuel additive *will endanger the public health or welfare* . . . .

CAA section 211(c)(1)(A) (1970) (emphasis added). The italicized language in the above quote is the relevant language revised by the 1977 amendments.

541 F.2d at 6. After reviewing the relevant facts and law, the full-court evaluated the statutory language at issue to see what level of "certainty [was] required by the Clean Air Act before EPA may act." *Id*.

By a 2-1 vote, the 3-judge panel had held that the statutory language "will endanger" required proof of actual harm, and that the actual harm had to come from fuels "in and of themselves." *Id*. at 12. The en banc court rejected this approach, finding that the term "endanger" allowed the Administrator to act when harm is threatened, and did not require proof of actual harm. *Id*. at 13. "A statute allowing for regulation in the face of danger is, necessarily, a precautionary statute." *Id*. Optimally, the court held, regulatory action would not only precede, but prevent, a perceived threat. *Id*.

The court also rejected petitioners= argument that any threatened harm must be Aprobable@ before regulation was authorized. Specifically, the court recognized that danger Ais set not by a fixed probability of harm, but rather is composed of reciprocal elements of risk and harm, or probability or severity.@ *Id.* at 18. Next, the court held that EPA=s evaluation of risk is necessarily an exercise of judgment, and that the statute did not require a factual finding. *Id*. at 24. Thus, ultimately, the Administrator must Aact, in part on >factual issues,= but largely >on choices of policy, on an assessment of risks, [and] on predictions dealing with matters on the frontiers of scientific knowledge . . . .@ *Id*. at 29 (citations omitted). Finally, the en banc court agreed with EPA that even without the language in section 202 regarding Acause or contribute to,@ section 211 authorized EPA to consider the cumulative impact of lead from numerous sources, not just the fuels being regulated under section 211. *Id*. at 29-31.

b. The 1977 Clean Air Act Amendments

The dissent in the original Ethyl Corp decision and the en banc opinion were of Acritical importance@ to the House Committee which proposed the revisions to the endangerment language in the 1977 amendments to the CAA. H.R. Rep. 95-294 at 48, 4 LH at 2515. In particular, the Committee believed the Ethyl Corp decision posed several Acrucial policy questions@ regarding the protection of public health and welfare.*" Id*.[100] The Committee addressed those questions with the endangerment language that now appears in section 202(a) and several other CAA provisions -- "which in [the Administrator's] judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare."

The Committee intended the language to serve several purposes consistent with the en banc decision in Ethyl Corp.[101] First, the phrases Ain his judgment@ and Ain the judgment of the Administrator@ call for the Administrator to make comparative assessment of risks and projections of future possibilities, consider uncertainties, and extrapolate from limited data. Thus, the Administrator must balance the likelihood of effects with the severity of the effects in reaching his judgment. The Committee emphasized that Ajudgment@ is different from a factual Afinding.@ Importantly,

[100] The Supreme Court recognized that the current language in section 202(a)(1) is Amore-protective@ than the 1970 version that was similar to the section 211 language before the D.C. Circuit in *Ethyl Corp*. 127 S.Ct. at 1447, fn 1.

[101] Specifically, the language (1) emphasizes the precautionary or preventive purpose of the CAA; (2) authorizes the Administrator to reasonably project into the future and weigh risks; (3) requires the consideration of the cumulative impact of all sources; (4) instructs that the health of susceptible individuals, as well as healthy adults, should be part of the analysis; and (5) indicates an awareness of the uncertainties and limitations in information available to the Administrator. H.R. Rep. 95-294 at 49-50, 4 LH at 2516-17. Congress also wanted to standardize this language across the various sections of the CAA which address emissions from both stationary and mobile sources which may reasonably be anticipated to endanger public health or welfare. H.R. Rep. 95-294 at 50, 4 LH at 2517; Section 401 of CAA Amendments of 1977.

projections, assessments and estimates must be reasonable, and cannot be based on a A>crystal ball= inquiry." Moreover, procedural safeguards apply (e.g., CAA 307(d)) to the exercise of judgment, and final decisions are subject to judicial review. Also, the phrase Ain his judgment@ modifies both phrases Acause and contribute@ and Amay reasonably be anticipated@ discussed below. H.R. Rep. 95-294 at 50-51, 4 LH at 2517-18.

As the Committee further explained, the phrase Amay reasonably be anticipated@ builds upon the precautionary and preventative goals already provided in the use of the term Aendanger.@ Thus, the Administrator is to assess current and future risks rather than wait for proof of actual harm. This phrase is also intended to instruct the Administrator to consider the limitations and difficulties inherent in information on public health and welfare. H.R. Rep. 95-294 at 51, 4 LH at 2518.

Finally, the phrase Acause or contribute@ ensures that all sources of the contaminant which contribute to air pollution be considered in the endangerment analysis (e.g., not a single source or category of sources). It is also intended to require the Administrator to consider all sources of exposure to a pollutant (e.g., food, water, air) when determining risk. *Id*.

3. Additional Considerations for the "Cause or Contribute" Analysis

While the legislative history sheds light on what should be considered in making an endangerment finding, it is not clear regarding what constitutes a sufficient "contribution" for purposes of making a finding. The CAA does not define the concept

Acause or contribute@ and instead requires that the Administrator exercise his judgment when determining whether emissions of air pollutants cause or contribute to air pollution. As a result, the Administrator has the discretion to interpret Acause or contribute@ in a reasonable manner when applying it to the circumstances before him.

The D.C. Circuit has discussed the concept of Acontribution@ in the context of a CAA section 213 rule for nonroad vehicles. In Bluewater Network v. EPA, 370 F.3d 1 (2004), industry argued that section 213(a)(3) requires a finding of a significant contribution before EPA could regulate, but EPA argued that the CAA requires a finding only of Acontribution.@[102] *Id*. at 13. The court looked at the Aordinary meaning of >contribute=@ when upholding EPA's reading. After referencing dictionary definitions of contribute,[103] the court also noted that A[s]tanding alone, the term has no inherent connotation as to the magnitude or importance of the relevant >share= in the effect; certainly it does not incorporate any >significance= requirement.@ *Id*.[104] The court also found relevant the fact that section 213(a) uses the term Asignificant contributor@ in some places and the term Acontribute@ elsewhere, suggesting that the "contribute" language

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[102] The relevant language in section 213(a)(3) reads A[i]f the Administrator makes an affirmative determination under paragraph (2) the Administrator shall, . . . promulgate (and from time to time revise) regulations containing standards applicable to emissions from those classes or categories of new nonroad engines and new nonroad vehicles (other than locomotives or engines used in locomotives) which in the Administrator's judgment cause, or contribute to, such air pollution.@ Notably, CAA section 213(a)(2), which is referenced in section 213(a)(3), requires that the AAdministrator shall determine . . . whether emissions of carbon monoxide, oxides of nitrogen, and volatile organic compounds from new and existing nonroad engines or nonroad vehicles (other than locomotives or engines used in locomotives) are *significant contributors* to ozone or carbon monoxide concentrations in more than 1 area which has failed to attain the national ambient air quality standards for ozone or carbon monoxide@ (emphasis added).

[103] Specifically, the decision noted that "=contribute= means simply >to have a share in any act or effect,= Webster's Third New International Dictionary 496 (1993), or >to have a part or share in producing,= 3 Oxford English Dictionary 849 (2d ed. 1989).@ 370 F.3d at 13.

[104] The court explained, AThe repeated use of the term >significant= to modify the contribution required for all nonroad vehicles, coupled with the omission of this modifier from the >cause, or contribute to= finding required for individual categories of new nonroad vehicles, indicates that Congress did not intend to require a finding of >significant contribution= for individual vehicle categories.@ *Id*.

invests the Administrator with discretion to exercise his judgment regarding what constitutes a sufficient contribution for the purpose of making an endangerment finding. *Id*. at 14

In the past the Administrator has looked at emissions of air pollutants in various ways to determine whether they Acause or contribute@ to the relevant air pollution. For instance, in some mobile source rulemakings, the Administrator has looked at the percent of emissions from the regulated mobile source category compared to the total mobile source inventory for that air pollutant. *See, e.g.,* 66 FR 5001 (2001) (heavy duty engine and diesel sulfur rule). In other instances the Administrator has looked at the percent of emissions compared to the total nonattainment area inventory of the air pollution at issue. *See, e.g.,* 67 FR 68,242 (2002) (snowmobile rule). EPA has found that air pollutant emissions that amount to 1.2% of the total inventory Acontribute.@ Bluewater Network, 370 F.3d at 15 (AFor Fairbanks, this contribution was equivalent to 1.2% of the total daily CO inventory for 2001.@).

We solicit comment on these prior precedents, including their relevance to contribution findings EPA may be considering regarding GHG emissions. Where appropriate, may the Administrator determine that emissions at a certain level or percentage contribute to air pollution in one instance, while also finding that the same level or percentage of another air pollutant and involving different air pollution, and different overall circumstances, does not contribute? When exercising his judgment, is it appropriate for the Administrator to consider not only the cumulative impact, but also the totality of the circumstances (e.g., the air pollutant, the air pollution, the type of source category, the number of sources in the source category, the number and type of other source categories that may emit the air pollutant) when determining whether the emissions Ajustify regulation@ under the CAA? *See* Ethyl Corp., 541 F.2d at 31, n62 (AMoreover, even under a cumulative impact theory emissions must make more than a minimal contribution to total exposure in order to justify regulation under § 211(c)(1)(A).@).

B. Is the Air Pollution at Issue Reasonably Anticipated to Endanger Public Health or Welfare?

This section discusses options for defining, with respect to GHGs, the "air pollution" that may or may not be reasonably anticipated to endanger public health or welfare, the first part of the two part endangerment test. It also summarizes the state of the science on GHGs and climate change, and relates that science to the endangerment question. We solicit comment generally on the information and issues discussed below.

1. What is the Air Pollution?

As noted above, in applying the endangerment test in section 202(a) or other sections of the Act to GHG emissions, the Administrator must define the scope and nature of the relevant "air pollution" that may or may not be reasonably anticipated to endanger public health or welfare. The endangerment issue discussed in today's notice involves, primarily, anthropogenic emissions of GHGs, the accumulation of GHGs in the atmosphere, the resultant impacts including climate change, and the risks and impacts to human health and welfare associated with those impacts.

a. The Six Major GHGs of Concern

The six major GHGs of concern are CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6. The IPCC focuses on these six GHGs for both scientific assessments and emissions inventory purposes because these are the six long-lived, well-mixed GHGs not controlled by the Montreal Protocol on Substances that Deplete the Ozone Layer. These six GHGs are directly emitted by human activities, are reported annually in EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, and are the common focus of the climate change research community. The ICTA petition addresses the first four of these GHGs, and the President's Executive Orders 13423 and 13432 define GHGs to include all six of these GHGs.

Carbon dioxide is the most important GHG directly emitted by human activities, and is the most significant driver of climate change. The anthropogenic combined heating effect (referred to as forcing) of CH_4, N_2O, HFCs, PFCs and SF_6 is about 40% as large as the CO_2 cumulative heating effect since pre-industrial times, according to the Fourth Assessment Report of the IPCC.

b. Emissions and Elevated Concentrations of the Six GHGs

As mentioned previously, these six GHGs can remain in the atmosphere for decades to centuries. Therefore, these GHGs, once emitted, become well mixed throughout the global atmosphere regardless of their emission origin, such that their average concentrations over the U.S. are roughly the same as the global average. This also means that current GHG concentrations are the cumulative result of both historic and current emissions, and that future concentrations will be the cumulative result of historic, current and future emissions.

Greenhouse gases trap some of the Earth's heat that would otherwise escape to space. The additional heating effect caused by the buildup of anthropogenic GHGs in the atmosphere enhances the Earth's natural greenhouse effect and causes global temperatures to increase, with associated climatic changes (e.g., change in precipitation patterns, rise in sea levels, and changes in the frequency and intensity of extreme weather events). Current atmospheric concentrations of all of these GHGs are significantly higher than pre-industrial (~1750) levels as a result of human activities. Atmospheric concentrations of CO_2 and other GHGs are projected to continue to climb over the next several decades.

The scientific literature that assesses the potential risks and end-point impacts of climate change (driven by the accumulation of atmospheric concentrations of GHGs) does not assess these impacts on a gas-by-gas basis. Observed climate change and associated effects are driven by the buildup of all GHGs in the atmosphere, as well as other natural and anthropogenic factors that influence the Earth's energy balance. Likewise, the future projections of climate change that have been done are driven by emission scenarios of all six GHGs, as well as other pollutants, many of which are already regulated in the U.S. and other countries.

For these reasons, EPA is considering defining the "air pollution" related to GHGs as the elevated combined current and projected atmospheric concentration of the six GHGs. This approach is consistent with other provisions of the CAA and previous EPA practice under the CAA, where separate air pollutants from different sources but with common properties may be treated as a class (e.g., Class I and Class II substances under Title VI of the CAA). It also addresses the cumulative effect that the elevated concentrations of the six GHGs have on climate, and thus on different elements of health, society and the environment. We seek comment on this potential approach, as well as other alternative ways to define "air pollution." One alternative would be to define air pollution as the elevated concentration of an individual GHG; however, in this case the Administrator may still have to consider the impact of the individual GHG in combination with the impacts caused by the elevated concentrations of the other GHGs.

c. Other Anthropogenic Factors that have a Climatic Warming Effect beyond the Six Major GHGs

There are other GHGs and aerosols that have climatic warming effects: water vapor, chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, stratospheric and tropospheric ozone (O_3), and black carbon. Each of these is discussed here. We seek comment on whether and how they should be considered in the definition of "air pollution" for purposes of an endangerment finding.

Water vapor is the most abundant naturally occurring GHG and therefore makes up a significant share of the natural, background greenhouse effect. However, water vapor emissions from human activities have only a negligible effect on atmospheric concentrations of water vapor. Significant changes to global atmospheric concentrations of water vapor occur indirectly through human-induced global warming, which then increases the amount of water vapor in the atmosphere because a warmer atmosphere can hold more moisture. Therefore, changes in water vapor concentrations are not an initial driver of climate change, but rather an effect of climate change which then acts as a positive feedback that further enhances warming. For this reason, the IPCC does not list direct emissions of water vapor as an anthropogenic forcing agent of climate change, but does include this water vapor feedback mechanism in response to human-induced warming in all modeling scenarios of future climate change. Based on this recognition that anthropogenic emissions of water vapor are not a significant driver of anthropogenic climate change, EPA's annual *Inventory of U.S. Greenhouse Gas Emissions and Sinks* does not include water vapor, and GHG inventory reporting guidelines under the United Nations Framework Convention on Climate Change (UNFCCC) do not require data on water vapor emissions.

Water vapor emissions may be an issue for concern when they are emitted by aircraft at high altitudes, where, under certain conditions, they can lead to the formation of condensation trails, referred to as contrails. Similar to high-altitude, thin clouds, contrails have a warming effect. Extensive cirrus clouds can also develop from aviation contrails, and increases in cirrus cloud cover would also have a warming effect. The IPCC Fourth Assessment Report estimated a very small positive radiative forcing effect for linear contrails, with a low degree of scientific understanding. Unlike the warming effects associated with the six long-lived, well-mixed GHGs, the warming effects associated with contrails or contrail-induced cirrus cloud cover are more regional and temporal in nature. Further discussion of aviation contrails can be found in Section VI on mobile sources. EPA invites input and comment on the scientific and policy issues related to consideration of water vapor's association with aviation contrails in an endangerment analysis.

The CFCs, HCFCs, and halons are all strong anthropogenic GHGs that are long-lived in the atmosphere and are adding to the global anthropogenic heating effect. Therefore, these gases share common climatic properties with the six GHGs discussed above. The production and consumption of these substances (and hence their anthropogenic emissions) are being controlled and *phased out*, not because of their effects on climate change, but because they deplete stratospheric O_3, which protects against harmful ultraviolet B (UVB) radiation. The control and phase-out of these substances in the U.S. and globally is occurring under the Montreal Protocol on Substances that Deplete the Ozone Layer, and in the U.S. under Title VI of the CAA as well.[105] Therefore, the climate change research and policy community typically does not focus on these substances, precisely because they are essentially already being 'taken

[105] Under the Montreal Protocol, production and consumption of CFCs were phased out in developed countries in 1996 (with some essential use exemptions) and are scheduled for phase-out by 2010 in developing countries (with some essential use exemptions). For halons the schedule was 1994 for phase out in developed countries and 2010 for developing countries; HCFC production was frozen in 2004 in developed countries, and in 2016 production will be frozen in developing countries; and HCFC consumption phase-out dates are 2030 for developed countries and 2040 in developing countries.

care of' with non-climate policy mechanisms. For example, the UNFCCC does not address these substances, and instead defers their treatment to the Montreal Protocol. As mentioned above, the President's Executive Orders 13423 and 13432 do not include these substances in the definition of GHGs. For these reasons, EPA's preliminary conclusion is that we would not include CFCs, HCFCs and halons in the definition of "air pollution" for purposes of an endangerment finding. We seek comment on this issue.

The depletion of stratospheric O_3 due to CFCs, HCFCs, and other ozone-depleting substances has resulted in a small cooling effect on the planet.

Increased concentrations of tropospheric O_3 are causing a significant anthropogenic warming effect, but, unlike the long-lived six GHGs, tropospheric O_3 has a short atmospheric lifetime (hours to weeks), and therefore its concentrations are more variable over space and time. For these reasons, its global heating effect and relevance to climate change tends to entail greater uncertainty compared to the well-mixed, long-lived GHGs. More importantly, tropospheric ozone is already listed as a NAAQS pollutant and is regulated through SIPs and other measures under the CAA, due to its direct health effects including increases in respiratory infection, medicine use by asthmatics, emergency department visits and hospital admissions, and its potential to contribute to premature death, especially in susceptible populations such as asthmatics, children and the elderly. Tropospheric O_3 is not addressed under the UNFCCC. For these reasons, EPA's preliminary conclusion is that we would not include tropospheric O_3 in the definition of "air pollution" for purposes of an endangerment finding because, as with CFCs, HCFCs and halons, it is already being addressed by regulatory actions that control precursor emissions (NOx and volatile organic compounds (VOCs)) from major U.S. sources. We invite comment on this issue.

Black carbon is an aerosol particle that results from incomplete combustion of the carbon contained in fossil fuels, and it remains in the atmosphere for about a week. Black carbon causes a warming effect by absorbing incoming sunlight in the atmosphere (whereas GHGs cause warming by trapping outgoing, infrared heat), and by darkening bright surfaces such as snow and ice, which reduces reflectivity and increases absorption of sunlight at the surface. Some recent research,[106] published after the IPCC Fourth Assessment Report, has suggested that black carbon may play a larger role in warming that previously thought. Like other aerosols, black carbon can also alter the reflectivity and lifetime of clouds, which in turn can have an additional climate effect. How black carbon and other aerosols alter cloud properties is a key source of uncertainty in climate change science. Given these reasons, there is considerably more uncertainty associated with black carbon's warming effect compared to the estimated warming effect of the six long-lived GHGs.

Black carbon is also co-emitted with organic carbon, which tends to have a cooling effect on climate because it reflects and scatters incoming sunlight. The ratio of black carbon to organic carbon varies by fuel type and by combustion efficiency. Diesel vehicles, for example, emit a much greater portion of black carbon, whereas forest fires tend to emit much more organic carbon. The net effect of black carbon and organic carbon on climate should therefore be considered. Also, black carbon is a subcomponent of particulate matter (PM), which is regulated as a NAAQS pollutant under the CAA due

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[106] Ramathan, V, and G. Carmichael (2008) Global and regional climate changes due to black carbon. *Nature Geoscience*, 1: 221-227.

to its direct health effects caused by inhalation. Diesel vehicles are estimated to be the largest source of black carbon in the U.S., but these emissions are expected to decline substantially over the coming decades due to recently promulgated EPA regulations targeting $PM_{2.5}$ emissions from on-road and off-road diesel vehicles (the Highway Diesel Rule and the Clean Air Nonroad Diesel Rule, the Locomotive and Marine Compression Ignition Rule). Non-regulatory partnership programs such as the National Clean Diesel Campaign and Smartway are reducing black carbon as well. In sum, black carbon has different climate properties compared to long-lived GHGs, and major U.S. sources of black carbon are already being aggressively reduced through regulatory actions due to health concerns. Nevertheless, EPA has recently received petitions asking the Agency to reduce black carbon emissions from some mobile source categories (see Section VI.). Therefore, EPA seeks comment on how to treat black carbon (and co-emitted organic carbon) regarding the definition of "air pollution" in the endangerment context.

2. Science Summary

The following provides a summary of the underlying science that was reviewed and utilized in the Endangerment Technical Support Document for the endangerment discussion, which in turn relied heavily on the IPCC Fourth Assessment Report. We seek comment on the best available science for purposes of the endangerment discussion, and in particular on the use of the more recent findings of the U.S. Climate Change Science Program.

a. Observed Global Effects

The global atmospheric CO_2 concentration has increased about 35% from pre-industrial levels to 2005, and almost all of the increase is due to anthropogenic emissions. The global atmospheric concentration of CH_4 has increased by 148% since pre-industrial levels. Current atmospheric concentrations of CO_2 and CH_4 far exceed the recorded natural range of the last 650,000 years. The N_2O concentration has increased 18%. The observed concentration increase in these non-CO_2 gases can also be attributed primarily to anthropogenic emissions. The industrial fluorinated gases, HFCs, PFCs, and SF_6, have relatively low atmospheric concentrations but are increasing rapidly; these gases are entirely anthropogenic in origin.

Current ambient concentrations of CO_2 and other GHGs remain well below published thresholds for any direct adverse health effects, such as respiratory or toxic effects.

The global average net effect of the increase in atmospheric GHG concentrations, plus other human activities (e.g., land use change and aerosol emissions), on the global energy balance since 1750 has been one of warming. This total net radiative forcing (a measure of the heating effect caused by changing the Earth's energy balance) is estimated to be +1.6 Watts per square meter (W/m^2). The combined radiative forcing due to the cumulative (i.e., 1750 to 2005) increase in atmospheric concentrations of CO_2, CH_4, and N_2O is +2.30 W/m^2. The rate of increase in positive radiative forcing due to these three GHGs during the industrial era is very likely to have been unprecedented in more than 10,000 years. The positive radiative forcing due to the increase in CO_2 concentrations is the largest (+1.66 W/m^2). The increase in CH_4 concentrations is the second largest source of positive radiative forcing (+0.48 W/m^2). The increase in N_2O has a positive radiative forcing of +0.16 W/m^2.

Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. Global mean surface temperatures have risen by 0.74°C (1.3ºF) over the last 100 years. The average rate of warming over the last 50 years is almost double that over the last 100 years. Global mean surface temperature was higher during the last few decades of the 20th century than during any comparable period during the preceding four centuries

Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations. Global observed temperatures over the last century can be reproduced only when model simulations include both natural and anthropogenic forcings, i.e., simulations that remove anthropogenic forcings are unable to reproduce observed temperature changes. Thus, the warming cannot be explained by natural variability alone.

Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases. Observations show that changes are occurring in the amount, intensity, frequency and type of precipitation. There is strong evidence that global sea level gradually rose in the 20th century and is currently rising at an increased rate. Widespread changes in extreme temperatures have been observed in the last 50 years. Globally, cold days, cold nights, and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent.

The Endangerment Technical Support Document provides evidence that the U.S. and the rest of the world are experiencing effects from climate change now.

b. Observed U.S. Effects

U.S. temperatures also warmed during the 20th and into the 21st century. U.S. temperatures are now approximately 1.0ºF warmer than at the start of the 20th century, with an increased rate of warming over the past 30 years. The past nine years have all been among the 25 warmest years on record for the contiguous U.S., a streak which is unprecedented in the historical record. Like the average global temperature increase, the observed temperature increase for North America has been attributed to the global buildup of anthropogenic GHG concentrations in the atmosphere

Widespread changes in extreme temperatures have been observed in the last 50 years across all world regions including the U.S. Cold days, cold nights, and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent.

Total annual precipitation has increased over the U.S. on average over the last century (about 6%), and there is evidence of an increase in heavy precipitation events. Nearly all of the Atlantic Ocean shows sea level rise during the past decade with highest rate in areas that include the U.S. east coast.

Observations show that climate change is currently impacting the nation's ecosystems and services in significant ways.

c. Projected Effects

The Endangerment Technical Support Document, the IPCC Fourth Assessment Report, and a report under the U.S. Climate Change Science Program, provide projections of future ambient concentrations of GHGs, future climate change, and future anticipated effects from climate change under various scenarios. This section summarizes some of the key global projections, such as changes in global temperature, as well as those particular to North America and the United States.

Overall risk to human health, society and the environment increases with increases in both the rate and magnitude of climate change. Climate warming may increase the possibility of large, abrupt, and worrisome regional or global climatic events (e.g., disintegration of the Greenland Ice Sheet or collapse of the West Antarctic Ice Sheet). The majority of the climate change impacts literature assesses the potential effects on health, society and the environment due to projected changes in average conditions (e.g., temperature increase, precipitation change, sea level rise) and do not take into account how the frequency and severity of extreme events due to climate change may cause certain additional impacts. Likewise, impact studies typically do not account for large, abrupt climatic events, and generally consider rates of warming that would result from climate sensitivities[107] within the most likely range, not at the tails of the

[107] "Climate sensitivity" is a term used to describe how much long-term global warming occurs if global atmospheric concentrations of CO_2 are doubled compared to their pre-industrial levels. The IPCC Fourth

distribution. To weigh the full range of risks and impacts, it is important to consider these possible extreme outcomes, including those that are of low probability.

i Global Effects

The majority of future reference-case scenarios (assuming no explicit GHG mitigation actions beyond those already enacted) project an increase of global GHG emissions over the century, with climbing GHG concentrations and associated increases in radiative forcing and average global temperatures.

Projected ambient concentrations of CO_2 and other GHGs remain well below published thresholds for any direct adverse health effects, such as respiration or toxic effects.

Through about 2030, the global warming rate is affected little by different future scenario assumptions or different model sensitivities, because there is already some degree of commitment to future warming given past and present GHG emissions. By mid-century, the choice of scenario becomes more important for the magnitude of the projected warming because only about a third of that warming is projected to be due to climate change that is already committed. By the end of the century, projected average global warming (compared to average temperature around 1990) varies significantly by emissions scenario, with IPCC's best estimates ranging from 1.8 to 4.0°C (3.2 to 7.2°F),

Assessment Report states that climate sensitivity is very likely greater than 1.5°C (2.7°F) and likely to lie in the range of 2°C to 4.5°C (3.6°F to 8.1°F), with a most likely value of about 3°C (5.4°F), and that a climate sensitivity higher than 4.5°C cannot be ruled out.

with a fuller likely range of 1.1 to 6.4°C (2.0 to 11.5°F), which takes into account a wider range of future emission scenarios and a wider range of uncertainties.[108]

The IPCC identifies the most vulnerable world regions as the Arctic, because of high rates of projected warming on natural systems; Africa, especially the sub-Saharan region, because of current low adaptive capacity; small islands, due to high exposure of population and infrastructure to risk of sea-level rise and increased storm surge; and Asian mega deltas, due to large populations and high exposure to sea level rise, storm surge, and river flooding. Climate change impacts in certain regions of the world may exacerbate problems that raise humanitarian and national security issues for the U.S. Climate change has been described as a potential threat multiplier regarding national security issues.

ii. United States Effects

Projected global warming is anticipated to lead to effects in the U.S. For instance, all of the U.S. is very likely to warm during this century, and most areas of the U.S. are expected to warm by more than the global average. The U.S, along with the rest of the world, is projected to see an increase in the intensity of precipitation events and the risk of flooding, greater runoff and erosion, and thus the potential for adverse water quality effects.

Severe heat waves are projected to intensify in magnitude, frequency, and duration over the portions of the U.S. where these events already occur, with likely

[108] The IPCC scenarios are also described in the Technical Support Document and include a range of future global emission scenarios and a range of climate sensitivities (which measure how much global warming occurs for a given increase in global CO_2 concentrations).

increases in mortality and morbidity, especially among the elderly, young, and frail. Warmer temperatures can also lead to fewer cold-related deaths. It is currently not possible to quantify the balance between decreased cold-related deaths and increased heat-related deaths attributable to climate change over time.

The IPCC projects with virtual certainty (i.e., greater than 99% likelihood) declining air quality in cities due to warmer days and nights, and fewer cold days and nights, and/or more frequent hot days and nights over most land areas, including the U.S. Climate change is expected to lead to increases in regional ozone pollution, with associated risks for respiratory infection, aggravation of asthma, and potential premature death, especially for people in susceptible groups. Climate change effects on ambient PM are currently less certain.

Additional human health concerns include a change in the range of vector-borne diseases, and a likely trend towards more intense hurricanes (even though any single hurricane event cannot be attributed to climate change) and other extreme weather events. For many of these issues, sensitive populations, such as the elderly, young, asthmatics, the frail and the poor, are most vulnerable.

Moderate climate change in the early decades of the century is projected to increase aggregate yields of rainfed agriculture in the United States by 5-20%. However, as temperatures continue to rise, grain and oilseed crops will increasingly experience failure, especially if climate variability increases and precipitation lessens or becomes more variable. How climatic variability and extreme weather events will continue to change under a changing climate is a key uncertainty, and these events also have the potential to offset the benefits of CO_2 fertilization and a longer growing season.

Climate change is projected to constrain over-allocated water resources in the U.S., increasing competition among agricultural, municipal, industrial, and ecological uses. Rising temperatures will diminish snowpack and increase evaporation, affecting seasonal availability of water.

Disturbances like wildfire and insect outbreaks are increasing and are likely to intensify in a warmer future with drier soils and longer growing seasons. Overall forest growth in the U.S. will likely increase by 10-20% as a result of extended growing seasons and elevated CO_2 over the next century, but with important spatial and temporal variation. Although recent climate trends have increased vegetation growth in parts of the United States, continuing increases in disturbances are likely to limit carbon storage, facilitate invasive species, and disrupt ecosystem services.

The U.S. will be affected by global sea level rise, which is expected to increase between 0.18 and 0.59 meters by the end of the century relative to around 1990. These numbers represent the lowest and highest projections of the 5 to 95% ranges for all scenarios considered collectively and include neither uncertainty in carbon cycle feedbacks nor rapid dynamical changes in ice sheet flow. U.S. coastal communities and habitats will be increasingly stressed by climate change interacting with development and pollution. Sea level is already rising along much of the coast, and the rate of change is expected to increase in the future, exacerbating the impacts of progressive inundation, storm-surge flooding, and shoreline erosion.

Climate change is likely to affect U.S. energy use (e.g., heating and cooling requirements), and energy production (e.g., effects on hydropower), physical infrastructures (including coastal roads, railways, transit systems and runways) and institutional infrastructures. Climate change will likely interact with and possibly exacerbate ongoing environmental change and environmental pressures in some settlements, particularly in Alaska where indigenous communities are facing major environmental and cultural impacts.

3. Endangerment Discussion regarding Air Pollution

The Administrator must exercise his judgment in evaluating whether the first part of the endangerment test is met, i.e., whether air pollution (e.g., the elevated concentrations of GHGs) is reasonably anticipated to endanger public health or welfare. As discussed above, in exercising his judgment it is appropriate for the Administrator to make comparative assessments of risk and projections of future possibilities, consider uncertainties, and extrapolate from limited data. The precautionary nature of the statutory language also means that the Administrator should act to prevent harm rather than wait for proof of actual harm.

The scientific record shows there is compelling and robust evidence that observed climate change can be attributed to the heating effect caused by global anthropogenic GHG emissions. The evidence goes beyond increases in global average temperature to include observed changes in precipitation patterns, sea level rise, extreme hot and cold days, sea ice, glaciers, ecosystem functioning and wildlife patterns. Global warming trends over the last 50 years stand out as significant compared to estimated global average temperatures for at least the last few centuries. Some degree of future warming is now unavoidable given the current buildup of atmospheric concentrations of GHGs, as the result of past and present GHG emissions. Based on the scientific evidence, it is reasonable to conclude that future climate change will result from current and future emissions of GHGs. Future warming over the course of the 21st century, even under scenarios of low emissions growth, is very likely to be greater than observed warming over the past century.

The range of potential impacts that can result from climate change spans many elements of the global environment, and all regions of the U.S. will be affected in some way. The U.S. has a long and populous coastline. Sea level rise will continue and exacerbate storm-surge flooding and shoreline erosion. In areas where heat waves already occur, they are expected to become more intense, more frequent, and longer lasting. Wildfires and the wildfire season are already increasing and climate change is expected to continue to worsen conditions that facilitate wildfires. Where water resources are already scarce and over-allocated in the western U.S., climate change is expected to put additional strain on these water management issues for municipal, agricultural, energy and industrial uses. Climate change also introduces an additional stress on ecosystems which are already affected by development, habitat fragmentation, and broken ecological dynamics. There is a wide range in the magnitude of these estimated impacts, with there being more confidence in the occurrence of some effects and less confidence in the occurrence of others.

In addition to the effects from changes in climate, there are some additional welfare effects that occur directly from the anthropogenic GHG emissions themselves. For example, ocean acidification occurs through elevated concentrations of CO_2, and crop and other vegetation growth can be enhanced through elevated CO_2 concentrations as well.

Current and projected levels of ambient concentrations of the six GHGs are not expected to cause any direct adverse health effects, such as respiratory or toxic effects, which would occur as a result of the elevated GHG concentrations themselves rather than through the effects of climate change. However, there are indirect human health risks (e.g., heat-related mortality, exacerbated air quality, extreme events) and benefits (e.g., less cold-related mortality) that occur due to climate change. We seek comment on how these human health impacts should be characterized under the CAA for purposes of an endangerment analysis.

Some elements of human health, society and the environment may benefit from climate change (e.g., short-term increases in agricultural yields, less cold-related mortality). We seek comment on how the potential for some benefits should be viewed against the full weight of evidence showing numerous risks and the potential for adverse impacts.

Quantifying the exact nature and timing of impacts due to climate change over the next few decades and beyond, and across all vulnerable elements of U.S. health, society and the environment, is currently not possible. However, the full weight of evidence as summarized above and as documented in the Endangerment Technical Support Document points towards the robust conclusion that expected rates of climate change (driven by past, present and plausible future GHG emissions) pose a number of serious risks to the U.S., even if the exact nature of the risks is difficult to quantify with confidence. The uncertainties in this context can also mean that future rates of climate change are being underestimated, and that the potential for associated and difficult-to-predict-and-quantify extreme events is not adequately incorporated into impact assessments. The scientific literature states that risk increases with increases in both the rate and magnitude of climate change. We solicit comment on how these uncertainties should be considered.

We seek comment on whether, in light of the precautionary nature of the statutory language, the Administrator needs to find that *current* levels of GHG concentrations endanger public health or welfare now. As noted above, the fact that GHGs remain in the atmosphere for decades to centuries means that future concentrations are dependent not only on tomorrow's emissions, but also on today's emissions. Should the Administrator consider both current and projected future elevated concentrations of GHGs, as well as the totality of the observed and projected effects that result from current and projected concentrations? Or should the Administrator focus on future projected elevated concentrations of GHGs and their projected effects in the United States because they are larger and of greater concern than current GHG concentrations and observed effects?

In sum, EPA invites comment on all issues relevant to making an endangerment finding, including the scientific basis supporting a finding that there is or is not endangerment under the CAA, as well as the potential scope of the finding (i.e., public health, welfare, or both).

C. Illustration for the "Cause or Contribute" Part of the Endangerment Discussion: Do emissions of air pollutants from motor vehicles or fuels cause or contribute to the air pollution that may reasonably be anticipated to endanger public health or welfare in the United States?

1. What Is/Are the Air pollutant(s)?

a. Background and Context

If the Administrator, in his judgment, finds that GHG "air pollution" may reasonably be anticipated to endangerment public health or welfare, he must then define "air pollutant(s)" for purposes of making the "cause or contribute" determination. The question is whether the "air pollutants" to be evaluated for "cause or contribute" should be the individual GHGs, or whether the "air pollutant" is one or more classes of GHGs as a group.

We recognize that the alternative definitions could have important implications for how GHGs are treated under other provisions of the Act. The Administrator seeks comment on these options, and is particularly interested in views regarding the implications for the potential future regulation of GHGs under other parts of the Act.

b. Defining "Air Pollutant" as Each Individual Greenhouse Gas

Under this approach, the Administrator could define "air pollutant" as each individual GHG rather than as GHGs as a collective whole for the purposes of assessing "cause or contribute." The Administrator would evaluate each individual GHG to determine if it causes, or contributes to, the elevated combined level of GHG concentrations.

This approach enables an evaluation of the unique characteristics and properties of each GHG (e.g., radiative forcing, lifetimes, etc.), as well as current and projected emissions. This facilitates a customized approach accounting for these factors. This approach also is consistent with the approach taken in several federal GHG programs which target reductions of individual greenhouse gases. For example, EPA manages a variety of partnership programs aimed at reducing emissions of specific sources of methane and the fluorinated gases (HFCs, PFCs and SF_6).

c. Defining "Air Pollutants" Collectively as a Class of Greenhouse Gases

Under this approach, the Administrator could define the "air pollutant" as (a) the collective group of the six GHGs discussed above (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6), (b) the collective group of the specific GHGs that are emitted from the relevant source category at issue in the endangerment finding (e.g,. for section 202 sources it would be CO_2, CH_4, N_2O, and HFCs), or (c) other reasonable groupings.

There are several federal and state climate programs, such as EPA's Climate Leaders program, DOE's 1605b program, and Multi-state Climate Registry, that encourage firms to report (and reduce) emissions of all six GHGs, recognizing that the non-CO_2 GHG emissions are a significant part of the atmospheric buildup of GHG concentrations and thus radiative forcing. In addition, the President's recent 2007 Executive Orders (13423 and 13432) and his 2002-2012 intensity goal both encompass the collective emissions of all six GHGs. Consideration of a class of gases collectively takes into account the multiple effects of mitigation options and technologies on each gas, thus enabling a more coordinated approach in addressing emissions from a source. For example, collection and combustion of fugitive methane will lead to net increases in CO_2 and possibly nitrous oxide emissions, but this is nevertheless desirable from an overall mitigation perspective given the lower total radiative forcing.

2. Discussion of "Cause or Contribute"

Once the "air pollutant(s)" is defined, the Administrator must look at the emissions of the air pollutant from the relevant source category in determining whether those emissions cause or contribute to the air pollution he has determined may reasonably be anticipated to endanger public health or welfare. There arguably are many possible ways of assessing "cause and contribute" and different approaches have been used in previous endangerment determinations under the CAA. For example, EPA could consider how emissions from the relevant source category would compare as a share of the following:

- total global aggregated emissions of the 6 GHGs discussed in the definition of "air pollution";
- total aggregated U.S. emissions of the 6 GHGs;
- total global emissions of the individual GHG in question;
- total U.S. emissions of the individual GHG in question; and
- total global atmospheric concentrations of the GHG in question.

In the past, the smallest level or amount of emissions that the Administrator determined "contributed" to the air pollution at issue was just less than 1% (67 FR 68,242 (2002)). We solicit comment on other factors that may be relevant to a contribution determination for GHG emissions. For example, given the global nature of the air pollution being addressed in this rulemaking, one might expect that the percentage contribution of specific GHGs and sectors would be much smaller than for previous rulemakings when the nature of the air pollution at issue was regional or local. On an absolute basis, a small U.S. GHG source on a global scale may have emissions at the same level as one of the largest sources in a single small to medium size country, and given the large size of the global denominator, even sectors with significant emissions could be very small in percentage terms.

In addition, EPA notes that the EPA promotes the reduction of particular GHG emissions through a variety of voluntary programs (e.g., EPA's domestic CH_4 partnership programs and the international Methane to Markets Partnership (launched in 2004)). EPA requests comment on how these and other efforts to encourage the voluntary reductions in even small amounts of GHG emissions are relevant to decisions about what level of "contribution" merits mandatory regulations.

Below we use the section 202 source category to illustrate these and other various ways to consider and compare source category GHG emissions for the "cause or contribute" analysis. In keeping with the discussion above regarding possible definitions of "air pollutant," we provide the information on an individual GHG and collective GHG basis. In addition, we raise various policy considerations that could be relevant to a "cause or contribute" determination. EPA invites comment on the various approaches, data, and policy considerations discussed below.

a. Overview of Section 202 Source Categories

The relevant mobile sources under section 202 (a)(1) of the Clean Air Act are "any class or classes of new motor vehicles or new motor vehicle engines, ..." CAA section 202(a)(1). To support this illustrative assessment, EPA analyzed historical GHG emissions data for motor vehicles and motor vehicle engines in the United States from 1990 to 2006.[109]

The motor vehicles and motor vehicle engines (hereinafter "section 202 source categories") addressed include passenger cars, light-duty trucks, motorcycles, buses, medium/heavy-duty trucks, and cooling.[110] Of the six primary GHGs, four are associated with section 202 source categories: CO_2, CH_4, N_2O, and HFCs.

A summary of the section 202 emissions information is presented here, and a more detailed description along with data tables is contained in the Emissions Technical Support Document. All annual emissions data are considered on a CO_2 equivalent basis.

b. Carbon Dioxide Emissions from Section 202 Sources

[109] The source of the emissions data is the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006 (USEPA #430-R-08-005)* (hereinafter "U.S. Inventory"). See the Emissions Technical Support Document for a discussion on the correspondence between Section 202 source categories and IPCC source categories. The most recent year for which official EPA estimates are available is 2006.
[110] Greenhouse gas emissions result from the use of HFCs in cooling systems designed for passenger comfort, as well as auxiliary systems for refrigeration.

CO_2 is emitted from motor vehicles and motor vehicle engines during the fossil fuel combustion process. During combustion, the carbon stored in the fuels is oxidized and emitted as CO_2 and smaller amounts of other carbon compounds.[111]

CO_2 is the dominant GHG emitted from motor vehicles and motor vehicle engines, and the dominant GHG emitted in the U.S. and globally.[112] CO_2 emissions from section 202 sources grew by 32% between 1990 and 2006, largely due to increased CO_2 emissions from light-duty trucks (61% since 1990) and medium/heavy-duty trucks (76%). Emissions of CO_2 from section 202 sources, and U.S. and global emissions are presented below in Table V-1.

Table V-1. Section 202 CO_2, U.S. and Global Emissions

U.S. Emissions	**2006**	**Sec 202 CO_2 Share**
Section 202 CO_2	1,564.6	
All US CO_2	5983.1	26.2%
US emissions of Sec 202 GHG	1,665.4	93.9%
All US GHG emissions	7,054.2	22.2%
Global Emissions	**2000**	**Sec 202 CO_2 Share (in 2000)**
All global CO_2 emissions	30,689.5	4.8%
Global transport GHG emissions	5,315.2	27.5%
All global GHG emissions	36,727.9	4.0%
Other Sources of U.S. CO_2	**2006**	**Share of U.S. CO_2 emissions**
Electricity Sector CO_2	2360.3	39.4%
Industrial Sector CO_2	984.1	16.4%

Arguably, based on these data, if the Administrator did not find that, for purposes of section 202, that CO_2 emissions from section 202 source categories contribute to the elevated combined level of GHG concentrations, it is unlikely that he would find that the other GHGs emitted by section 202 source categories contribute.

[111] Detailed CO_2 emissions data from section 202 source categories are presented in the Emissions Technical Support Document. Other carbon compounds emitted such as CO, and non-methane volatile organic compounds oxidize in the atmosphere to form CO_2 in period of hours to days.

[112] EPA typically uses current motor vehicle fleet emissions information when making a contribution analysis under section 202. We solicit comment on how or whether the reductions in CO_2 emissions expected by implementation of EISA, or any other projected change in emissions from factors such as growth in the fleet or vehicle miles traveled, would impact a contribution analysis for CO_2.

c. Methane Emissions from Section 202 Source Categories

Methane (CH_4) emissions from motor vehicles are a function of the CH_4 content of the motor fuel, the amount of hydrocarbons passing uncombusted through the engine, and any post-combustion control of hydrocarbon emissions (such as catalytic converters). Methane emissions from these source categories decreased by 58% between 1990 and 2006, largely due to decreased CH_4 emissions from passenger cars and light-duty trucks.[113] Emissions of CH_4 from section 202 sources, and U.S. and global emissions are presented below in Table V-2.

Table V-2. Section 202 CH_4, U.S. and Global Emissions

U.S. Emissions	**2006**	**Sec 202 CH_4 Share**
Section 202 CH_4	1.80	
All US CH_4	555.3	0.32%
US emissions of Sec 202 GHG	1,665.40	0.11%
All US GHG emissions	7,054.20	0.03%
Global Emissions	**2000**	**Sec 202 CH_4 Share (in 2000)**
All global CH_4 emissions	5,854.90	0.05%
Global transport GHG emissions	5,315.20	0.05%
All global GHG emissions	36,727.90	0.01%
Other Sources of U.S. CH_4	**2006**	**Share of U.S. CH_4 emissions**
Landfill CH_4 emissions	125.7	22.6%
Natural Gas CH_4 emissions	102.4	18.4%

EPA also notes that the EPA promotes the reduction of CH_4 and other non-CO_2 GHG emissions, as manifested in its domestic CH_4 partnership programs and the international Methane to Markets Partnership (launched in 2004), which are not focused on the transportation sector. EPA requests comment on how these and other efforts to encourage the voluntary reductions in even small amounts of GHG emissions are relevant to decisions about what level of "contribution" merits mandatory regulations.

[113] Detailed methane emissions data for section 202 source categories are presented in the Emissions Technical Support Document.

d. Nitrous Oxide Emissions from Section 202 Source Categories

Nitrous oxide (N_2O) is a product of the reaction that occurs between nitrogen and oxygen during fuel combustion. N_2O (and nitrogen oxide (NO_X)) emissions from motor vehicles and motor vehicle engines are closely related to fuel characteristics, air-fuel mixes, combustion temperatures, and the use of pollution control equipment.

Nitrous oxide emissions from section 202 sources decreased by 27% between 1990 and 2006, largely due to decreased emissions from passenger cars and light-duty trucks.[114] Earlier generation control technologies initially resulted in higher N_2O emissions, causing a 24% increase in N_2O emissions from motor vehicles between 1990 and 1995. Improvements in later-generation emission control technologies have reduced N_2O output, resulting in a 41% decrease in N_2O emissions from 1995 to 2006. Emissions of N_2O from section 202 sources, and U.S. and global emissions are presented below in Table V-3.

Table V-3. Section 202 N_2O, U.S. and Global Emissions

U.S. Emissions	**2006**	**Sec 202 N_2O Share**
Section 202 N_2O	29.5	
All US N_2O	367.9	8.0%
US emissions of Sec 202 GHG	1665.4	1.8%
All US GHG emissions	7054.2	0.4%
Global Emissions	**2000**	**Sec 202 N_2O Share (in 2000)**
All global N_2O emissions	3,113.8	1.6%
Global transport GHG emissions	5,315.2	0.9%
All global GHG emissions	36,727.9	0.1%
Other Sources of U.S. N_2O	**2006**	**Share of U.S. N_2O emissions**
Agricultural Soil N_2O emissions	265.0	72.0%
Nitric Acid N_2O emissions	15.6	4.3%

[114] Detailed nitrous oxide emissions data for section 202 source categories are presented in the Emissions Technical Support Document.

Past experience has shown that substantial emissions reductions can be made by small N_2O sources. For example, the N_2O emissions from adipic acid production is smaller than that of Section 202 sources, and this sector reduced its emission by over 60 percent from 1990 to 2006 as a result of voluntary adoption of N_2O abatement technology by the three major U.S. adipic acid plants.[115]

e. Hydrofluorocarbons Emissions from Section 202 Source Categories

Hydrofluorocarbons (a term which encompasses a group of eleven related compounds) are progressively replacing CFCs and HCFCs in section 202 cooling and refrigeration systems as they are being phased out under the Montreal Protocol and Title VI of the CAA.[116]

Hydrofluorocarbons were not used in motor vehicles or refrigerated rail and marine transport in the U.S. in 1990, but by 2006 emissions had increased to 70 Tg CO_2e.[117] Emissions of HFC from section 202 sources, and U.S. and global emissions are presented below in Table V-4

Table V-4. Section 202 HFC, U.S. and Global Emissions

U.S. Emissions	**2006**	**Sec 202 HFC Share**
Section 202 HFC	69.5	
All US HFC	124.5	55.8%
US emissions of Sec 202 GHG	1665.4	4.2%
All US GHG emissions	7054.2	1.0%
Global Emissions	**2000**	**Sec 202 HFC Share (in 2000)**
All global HFC emissions	259.2	20.3%
Global transport GHG emissions	5,315.2	1.0%

[115] *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006 (USEPA #430-R-08-005),* p.2-22.
[116] 2006 IPCC Guidelines, Volume 3, Chapter 7. Page 43.
[117] Detailed HFC emissions data for section 202 source categories are presented in Tables in the Emissions Technical Support Document.

All global GHG emissions	36,727.9	0.1%
Other Sources of U.S. HFC	**2006**	**Share of U.S. HFC emissions**
HCFC-22 Production	13.8	11.1%
Other ODS Substitutes	41.2	33.1%

EPA notes that section 202 HFC emissions are the largest source of HFC emissions in the United States, that these emissions increased by 274% from 1995 to 2006, and that section 202 sources are also the largest source of emissions of high GWP gases (i.e., HFCs, PFCs or SF_6) in the U.S. Thus, a decision not to set standards for HFCs under section 202 could be viewed as precedential with respect to the likelihood of future regulatory actions for any of these three gases.

f. Perfluorocarbons and Sulfur Hexafluoride

Perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6) are not emitted from motor vehicles or motor vehicle engines in the United States.

g. Total GHG Emissions from Section 202 Source Categories

We note if “air pollutant” were defined as the collective group of four to six GHGs, the emissions of a single component (e.g., CO_2) could theoretically support a positive contribution finding. We also solicit comment on whether the fact that total GHG emissions from section 202 source categories are approximately 4.3% of total global GHG emissions would mean that adopting this definition of “air pollutant” would make it unnecessary to assess the individual GHG emissions levels less than that amount.

Table V-5 below presents the contribution of individual GHGs to total GHG emissions from section 202 sources, and from all sources in the U.S.

Table V-5. Contribution of individual gases in 2006 to section 202 and U.S. total GHG

	CO_2	CH_4	N_2O	HFC	PFC	SF_6
Section 202	93.9%	0.1%	1.8%	4.2%		
U.S. Total	84.8%	7.9%	5.2%	1.8%	0.1%	0.2%

Emissions of GHG from section 202 sources, and U.S. and global emissions are presented below in Table V-6.

Table V-6. Section 202 GHG, U.S. and Global Emissions

U.S. Emissions	**2006**	**Sec 202 GHG Share**
Section 202 GHG	1665.4	
All US GHG emissions	7054.2	23.6%
Global Emissions	**2000**	**Sec 202 GHG Share (in 2000)**
Global transport GHG emissions	5,315.2	29.5%
All global GHG emissions	36,727.9	4.3%
Other Sources of U.S. GHG	**2006**	**Share of U.S. GHG emissions**
Electricity Sector emissions	2377.8	33.7%
Industrial Sector emissions	1371.5	19.4%

h. Summary of Requests for Comment

EPA is seeking comment on the approach outlined above in the context of section 202 source categories, regarding how “air pollutant” should be defined, and contribution analyzed. Specifically, EPA is interested in comments regarding the data and comparisons underlying the above example contained in Emissions Technical Support Document. We also welcome comment on prior precedents for assessing contributions, as well as the potential precedential impact of a positive section 202 contribution findings for other potential sources of these and other GHGs. We also welcome comment on the relationship of these proposals to existing U.S. climate change emissions reduction programs and the magnitude of reductions sought under these programs.

VI. Mobile Source Authorities, Petitions, and Potential Regulation

A. Mobile Sources and Title II of the Clean Air Act

Title II of the CAA provides EPA’s statutory authority for mobile source air pollution control. Mobile sources include cars and light trucks, heavy trucks and buses, nonroad recreational vehicles (such as dirt bikes and snowmobiles), farm and construction machines, lawn and garden equipment, marine engines, aircraft, and locomotives. The Title II program has led to the development and widespread commercialization of emission control technologies throughout the various categories of mobile sources. Overall, the new technologies sparked by EPA regulation over four decades have reduced the rate of emission of regulated pollutants from personal vehicles by 98% or more, and are key components of today’s high-tech cars and SUVs. EPA’s heavy-duty, nonroad, and transportation fuels regulatory programs have likewise promoted both pollution reduction and cost-effective technological innovation.

In this section, we consider how Title II authorities could be used to reduce GHG emissions from mobile sources and the fuels that power them. The existing mobile source emissions control program provides one possible model for how EPA could use Title II of the CAA to achieve long-term reductions in mobile source GHG emissions. The approach would be to set increasingly stringent performance standards that manufacturers would be required to meet over 10, 20 or 30 years using flexible compliance mechanisms like emissions averaging, trading and banking to increase the economic effectiveness of emission reductions over less flexible approaches. These performance standards would reflect EPA's evaluation of available and developing technologies, including the potential for technology innovation, that could provide sustained long-term GHG emissions reductions while allowing mobile sources to satisfy the full range of consumer and business needs.

Another approach we explore is the extent to which CAA authorities could be used to establish a cap-and-trade system for reducing mobile source-related GHG emissions that could provide even greater flexibility to manufacturers in finding least cost emission reductions available within the sector. With respect to cars and light trucks, we also present and discuss an alternative approach to standard-setting, focused on technology already in the market today in evaluating near term standards, that EPA began developing in 2007 as part of an inter-agency effort in response to the Massachusetts decision and the President's May 2007 directive. This approach took into consideration and used as a starting point the President's 20-in-10 goals for vehicle standards.

Congress subsequently addressed many of the 20-in-10 goals through its action in passing EISA in December 2007.

EPA seeks public comment on how a Title II regulatory program could serve as an approach for addressing GHG emissions from mobile sources. In addition, EPA invites comments on the following specific questions:

- What are the implications for developing Title II programs in view of the global and long-lived nature of GHGs?
- What factors should be considered in developing a long-term, i.e, 2050, GHG emissions target for the transportation sector?
- Should the transportation sector make GHG emission reductions proportional to the sector's share of total U.S. GHG emissions or should other approaches be taken to determining the relative contribution of the transportation sector to GHG emission reductions?
- What are the merits and challenges of different regulatory timeframes such as 5 years, 10-15 years, 30-40 years?
- Should Title II GHG standards be based on environmental need, current projections of future technology feasibility, and/or current projections of future net societal benefits?
- Could Title II accommodate a mobile sources cap-and-trade program and/or could Title II regulations complement a broader cap-and-trade program?
- Should trading between mobile sources and sources in other sectors be allowed?

- Is it necessary or would it be helpful to have new legislation to complement Title II (such as legislation to provide incentives for the development and commercialization of low-GHG mobile source technologies)?
- How best can EPA fulfill its CAA obligations under Title II yet avoid inconsistency with NHTSA's regulatory approach under EPCA?

EPA also invites comments on whether there are specific limitations of a Title II program that would best be addressed by new legislation.

1. Clean Air Act Title II Authorities

In this section we review the Title II provisions that could be applied to GHG emissions from various categories of motor vehicles and fuels. For each provision, we describe the relevant category of mobile sources, the terms of any required "endangerment" finding, and the applicable standard-setting criteria. We also identify the full range of factors EPA may consider, including costs and safety, and discuss the extent to which standards may be technology-forcing.

a. CAA Section 202(a)

Section 202(a)(1) provides broad authority to regulate new "motor vehicles," which are on-road vehicles. While other provisions of Title II address specific model years and emissions of motor vehicles, section 202(a)(1) provides the authority that EPA would use to regulate GHGs from new on-road vehicles. The ICTA petition sought motor vehicle GHG emission standards under this section of the Act.

As previously discussed, section 202(a)(1) makes a positive endangerment finding a prerequisite for setting emission standards for new motor vehicles. Any such standards "shall be applicable to such vehicles … for their useful life." Emission standards under CAA section 202(a)(1) are technology-based, i.e. the levels chosen must be premised on a finding of technological feasibility. They may also be technology-forcing to the extent EPA finds that technological advances are achievable in the available lead time and that the reductions such advances would obtain are needed and appropriate. However, EPA also has the discretion to consider and weigh various additional factors, such as the cost of compliance (see section 202(a) (2)), lead time necessary for compliance (section 202(a)(2)), safety (see NRDC v. EPA, 655 F. 2d 318, 336 n. 31 (D.C. Cir. 1981)) and other impacts on consumers, and energy impacts. Also see George E. Warren Corp. v. EPA, 159 F.3d 616, 623-624 (D.C. Cir. 1998). CAA section 202(a)(1) does not specify the weight to apply to each factor, and EPA accordingly has significant discretion in choosing an appropriate balance among the factors. See EPA's interpretation of a similar provision, CAA section 231, at 70 FR 69664, 69676 (Nov.17, 2005), upheld in NACAA v.EPA, 489 F.3d 1221, 1230 (2007).

b. CAA Section 213

CAA section 213 provides broad authority to regulate emissions of non-road vehicles and engines, which are a wide array of mobile sources including ocean-going vessels, locomotives, construction equipment, farm tractors, forklifts, harbor crafts, and lawn and garden equipment.

CAA section 213(a)(4) authorizes EPA to establish standards to control pollutants, other than NOx, volatile organic compounds and CO, which are addressed in section 213(a)(3), if EPA determines that emissions from nonroad engines and vehicles as a whole contribute significantly to air pollution "which may reasonably be anticipated to endanger public health or welfare". Once this determination is made, CAA section 213(a)(4) provides that EPA "may" promulgate standards it deems "appropriate" for "those classes or categories of new nonroad engines and new nonroad vehicles (other than locomotives or engines used in locomotives), which in the Administrator's judgment, cause or contribute to, such air pollution, taking into account costs, noise, safety, and energy factors associated with the application of available technology to those vehicles and engines." As with section 202(a)(1), this provision authorizes EPA to set technology-forcing standards to the extent appropriate considering all the relevant factors.

CAA section 213(a)(5) authorizes EPA to adopt standards for new locomotives and new locomotive engines. These standards must achieve the greatest degree of emissions reduction achievable through the application of available technology, giving appropriate consideration to the cost of applying such technology, lead time, noise, energy and safety. Section 213(a)(5) does not require that EPA review the contribution of locomotive emissions to air pollution which may reasonably be expected to endanger public health or welfare before setting emission standards, although in the past, EPA has provided such information in its rulemakings.

c. CAA Section 231

CAA section 231(a) provides broad authority for EPA to establish emission standards applicable to the "emission of any air pollutant from any class or classes of aircraft engines, which in the Administrator's judgment, causes, or contributes to, air pollution which may reasonably be anticipated to endanger public health or welfare." NACAA v. EPA, 489 F.3d 1221, 1229 (D.C. Cir. 2007). As with sections 202(a) and 213(a)(4), this provision authorizes, but does not require, EPA to set technology-forcing standards to the extent appropriate considering all the relevant factors, including noise, safety, cost and necessary lead time for the development and application of requisite technology.

Unlike the motor vehicle and non-road programs, however, EPA does not directly enforce its standards regulating aircraft engine emissions. Under CAA section 232, the Federal Aviation Administration (FAA) is required to prescribe regulations to insure compliance with EPA's standards. Moreover, FAA has authority to regulate aviation fuels, under Federal Aviation Act section 44714. However, under the Federal Aviation Act, the FAA prescribes standards for the composition or chemical or physical properties of an aircraft fuel or fuel additive to control or eliminate aircraft emissions the EPA "decides under section 231 of the CAA endanger the public health or welfare[.]"

d. CAA Section 211

Section 211(c) authorizes regulation of vehicle fuels and fuel additives (excluding aircraft fuel) as appropriate to protect public health and welfare, and section 211(o) establishes requirements for the addition of renewable fuels to the nation's vehicle fuel supply.[118] In relevant parts, section 211(c) states that, "[t]he Administrator may . . . by regulation, control or prohibit the manufacture, introduction into commerce, offering for sale, or sale of any fuel or fuel additive for use in a motor vehicle, motor vehicle engine, or nonroad engine or nonroad vehicle" if, in the judgment of the Administrator, any fuel or fuel additive or any emission product of such fuel or fuel additive causes, or contributes, to air pollution or water pollution (including any degradation in the quality of groundwater) which may reasonably be anticipated to endanger the public health or welfare, . . ." Similar to other CAA mobile source provisions, section 211(c)(1) involves an endangerment finding that includes considering the contribution to air pollution made by the fuel or fuel additive.

The Energy Policy Act of 2005 also added section 211(o) to establish the volume-based Renewable Fuels Standard program. Section 211(o) was amended by the Energy Independence and Security Act of 2007.

[118] EPA's authority to regulate fuels under CAA section 211 does not extend to aircraft engine fuel. Instead, under the Federal Aviation Act, the FAA prescribes standards for the composition or chemical or physical properties of an aircraft fuel or fuel additive to control or eliminate aircraft emissions the EPA "decides under section 231 of the Clean Air Act endanger the public health or welfare[.]" 49 U.S.C. 44714.

Section VI.D of this notice provides more information and discussion about the CAA section 211 authorities.

2. EPA's Existing Mobile Source Emissions Control Program

In this notice, EPA is examining whether and how the regulatory mechanisms employed under Title II to reduce conventional emissions could also prove effective for reducing GHG emissions. Under Title II, mobile source standards are technology-based, taking such factors as cost and lead time into consideration. Various Title II provisions authorize or require EPA to set standards that are technology forcing, such as standards for certain pollutants for heavy-duty or nonroad engines.[119] Title II also provides for comprehensive regulation of mobile sources so that emissions of air pollutants from all categories of mobile sources may be addressed as needed to protect public health and the environment.

Pursuant to Title II, EPA has taken a comprehensive, integrated approach to mobile source emission control that has produced benefits well in excess of the costs of regulation. In developing the Title II program, the Agency's historic, initial focus was on personal vehicles since that category represented the largest source of mobile source emissions. Over time, EPA has established stringent emissions standards for large truck and other heavy-duty engines, nonroad engines, and marine and locomotive engines, as

[119] Technology-forcing standards are based upon performance of technology that EPA determines will be available (considering technical feasibility, cost, safety, and other relevant factors) when the standard takes effect, as opposed to standards based upon technology which is already available. Technology-forcing standards further Congress' goal of having EPA project future advances in pollution control technology, rather than being limited by technology which already exists. NRDC v. Thomas, 805 F. 2d 410, 428 n. 30 (D.C. Cir. 1981). Technology-forcing standards are performance standards and do not require the development or use of a specific technology.

well. The Agency's initial focus on personal vehicles has resulted in significant control of emissions from these vehicles, and also led to technology transfer to the other mobile source categories that made possible the stringent standards for these other categories.

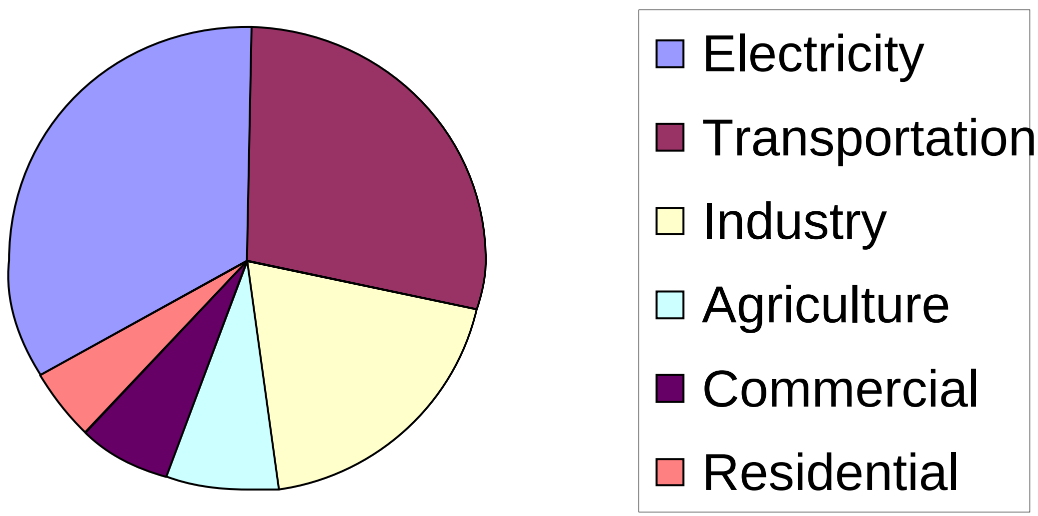
As a result of Title II requirements, new cars and SUVs sold today have emissions levels of hydrocarbons, oxides of nitrogen, and carbon monoxide that are 98-99% lower than new vehicles sold in the 1960s, on a per mile basis. Similarly, standards established for heavy-duty highway and nonroad sources require emissions rate reductions on the order of 90% or more for particulate matter and oxides of nitrogen. Overall ambient levels of automotive-related pollutants are lower now than in 1970, even as economic growth and vehicle miles traveled have nearly tripled. These programs have resulted in millions of tons of pollution reduction and major reductions in pollution-related deaths (estimated in the tens of thousands per year) and illnesses. The net societal benefits of the mobile source programs are large. In its annual reports on federal regulations, the Office of Management and Budget reports that many of EPA's mobile source emissions standards typically have projected benefit-to-cost ratios of 5:1 to 10:1 or more. Follow-up studies show that long-term compliance costs to the industry are typically lower than the cost projected by EPA at the time of regulation, which result in even more favorable real world benefit-to-cost ratios. Title II emission standards have also stimulated the development of a much broader set of advanced automotive technologies, such as on-board computers and fuel injection systems, which are at the core of today's automotive designs and have yielded not only lower emissions, but improved vehicle performance, reliability, and durability.

EPA requests comment on whether and how the approach it has taken under Title II could effectively be employed to reduce mobile source emissions of GHGs. In particular, EPA seeks comment and information on ways to use Title II authorities that would promote development and transfer of GHG control technologies for and among the various mobile source categories. The Agency is also interested in receiving information on the extent to which GHG-reducing technologies developed for the U.S. could usefully and profitably be exported around the world. Finally, EPA requests comments on how the Agency could implement its independent obligations under the CAA in a manner to avoid inconsistency with NHTSA CAFE rulemakings, in keeping with the Supreme Court's observation in the Massachusetts decision ("there is no reason to think the two agencies cannot both administer their obligations yet avoid inconsistencies").

3. Mobile Sources and GHGs

The domestic transportation sector emits 28% of total U.S. GHG emissions based on the standard accounting methodology used by EPA in compiling the inventory of U.S. GHG emissions pursuant to the United Nations Framework Convention on Climate Change (Figure VI-1).

Figure VI-1
U.S. GHG Emissions Allocated to Economic Sectors (2006)



The only economic sector with higher GHG emissions is electricity generation which accounts for 34% of total U.S. GHG emissions. However, the inventory accounting methodology attributes to other sectors two sources of emissions that EPA has the authority to regulate under Title II of the CAA. First, the methodology includes upstream transportation fuel emissions (associated with extraction, shipping, refining, and distribution, some of which occur outside of the U.S.) in the emissions of the industry sector, not the transportation sector. However, reducing transportation fuel consumption would automatically and proportionally reduce upstream transportation fuel-related GHG emissions as well. Second, nonroad mobile sources (such as construction, farm, and lawn and garden equipment) are also included in the industry sector contribution. All of these emissions can be addressed under CAA Title II authority, at least with respect to domestic usage. Including these upstream transportation fuel (some of which occur outside of U.S. boundaries) and nonroad equipment GHG emissions in the mobile sources inventory would raise the contribution from mobile sources and the fuels utilized by mobile sources to approximately 36% of total U.S. GHG emissions. Since, based on 2004 data, the U.S. emits about 23% of global GHG emissions, under the traditional accounting methodology the U.S. transportation sector contributes about 6% of the total global inventory. If upstream transportation fuel emissions and nonroad equipment emissions are also included, U.S. mobile sources are responsible for about 8% of total global GHG emissions.

Personal vehicles (cars, sport utility vehicles, minivans, and smaller pickup trucks) emit 54% of total U.S. transportation sector GHG emissions (including nonroad mobile sources), with heavy-duty vehicles the second largest contributor at 18%, aviation at 11%, nonroad sources at 8%, marine at 5%, rail at 3%, and pipelines at 1% (Figure VI-2). CO_2 is responsible for about 95% of transportation GHG emissions, with air conditioner refrigerant HFCs accounting for 3%, vehicle tailpipe nitrous oxide emissions for 2%, and vehicle tailpipe methane emissions for less than 1% (Figure VI-3).

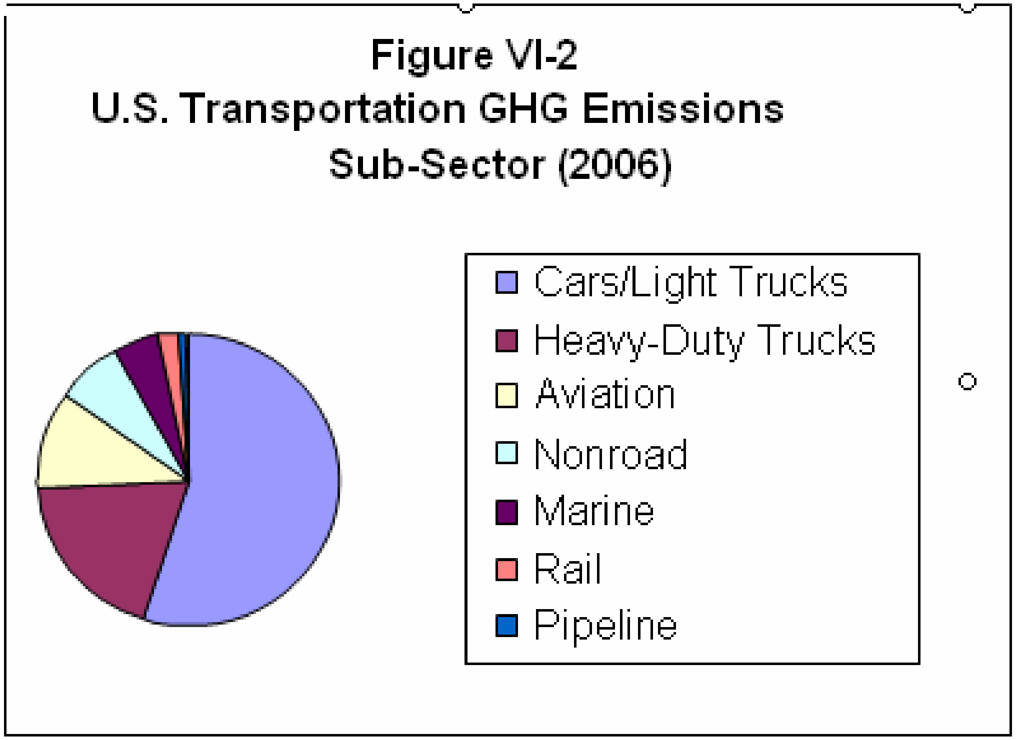


Figure VI-2
U.S. Transportation GHG Emissions
Sub-Sector (2006)
Cars/Light Trucks
Heavy-Duty Trucks
Aviation
Nonroad
Marine
Rail
Pipeline

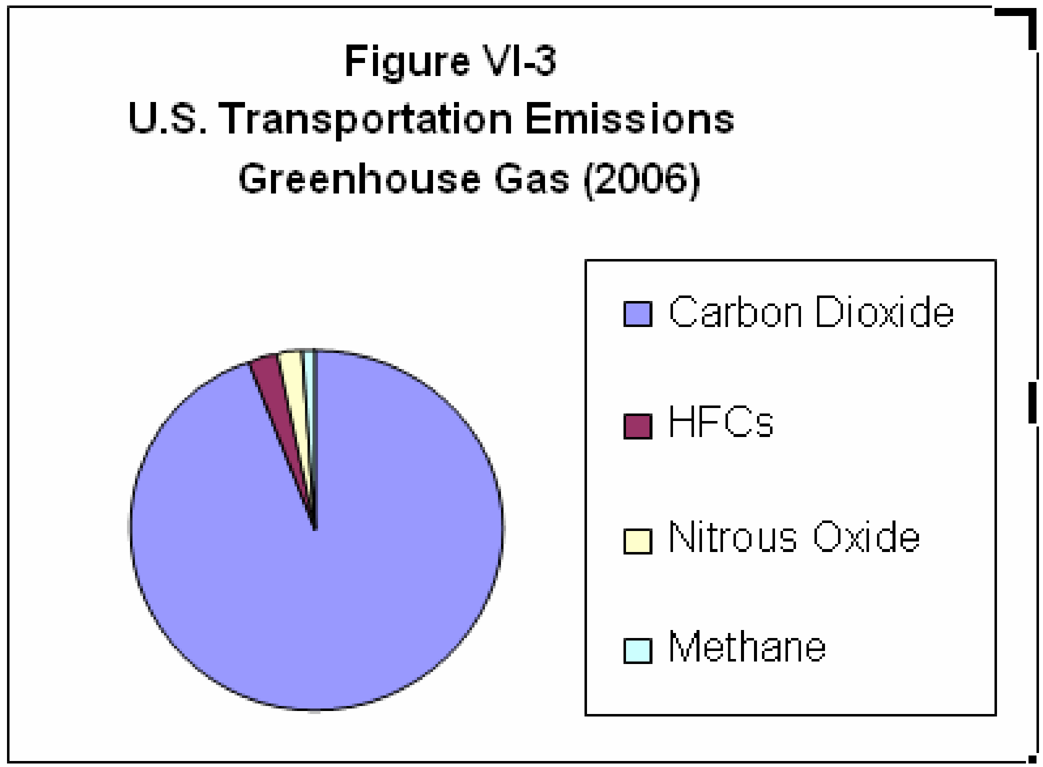


Figure VI-3
U.S. Transportation Emissions
Greenhouse Gas (2006)
Carbon Dioxide
HFCs
Nitrous Oxide
Methane

As noted previously, global climate change is a long-term problem. Climate experts such as the IPCC often use 2050 as a key reference point for future projections. Long-term projections of U.S. mobile source GHG emissions show that there is likely to be a major increase in transportation GHG emissions in the future.

Prior to the passage of EISA, U.S. transportation GHG emissions (including upstream fuel emissions) were projected to grow significantly, from about 2800 million metric tons in 2005 to about 4800 million metric tons in 2050 (see Figure VI-4, top curve). The fuel economy and renewable fuels provisions of EISA (Figure VI.A.2.-4, second curve from top) provide significant near-term mobile source GHG emissions reductions relative to the non-EISA baseline case. However, addressing climate change requires setting long-term goals. President Bush has proposed a new goal of stopping the growth of GHG emissions by 2025, and the IPCC has modeled several long-term climate mitigation targets for 2050.

Using Title II authority, mobile sources could achieve additional GHG emission reductions based on a variety of criteria including the amount of reduction needed, technological feasibility and cost effectiveness. While EISA's fuel economy and renewable fuel requirements will contribute to mobile source GHG emission reductions, its fuel economy standards affect only CO_2 emissions and do not apply to the full range of mobile source categories. EISA also specifies that fuel economy standards be set for no more than five years at a time, effectively limiting the extent to which those standards can take into account advancing technologies. Moreover, its renewable fuel provisions are limited in the extent to which they provide for GHG emission reductions, although

EISA does mandate the use of renewable fuels that meet different lifecycle GHG emission reduction requirements.

Under Title II, EPA has broad authority to potentially address all GHGs from all categories of mobile sources. In addition, Title II does not restrict EPA to specific timeframes for action. If circumstances warrant, EPA could set longer term standards and promote technological advances by basing standards on the performance of technologies not yet available but which are projected to be available at the time the standard takes effect. Title II also provides authority to potentially require GHG emission reductions from transportation fuels. Consequently, the CAA authorizes EPA to consider what GHG emissions reductions might be available and appropriate to require from the mobile source sector, consistent with the Act.

EPA has not determined what level of GHG emission reduction would be appropriate from the mobile source sector in the event a positive endangerment finding is made, although this ANPR includes some discussion of possible reductions. Any such determination is necessarily the province of future rulemaking activity. Without prejudging this important issue, and for illustrative purposes only, the final three curves in Figure VI-4 illustrate the additional reductions mobile sources would have to achieve if mobile sources were to make a proportional contribution to meeting the President's climate goal, the IPCC 450 CO_2 ppm stabilization scenario, and an economy-wide GHG emissions cap based on a 70% reduction in 2005 emissions by 2050. [120] As the figure illustrates, EISA provides about 25%, 15% and 10% of the transportation GHG emissions

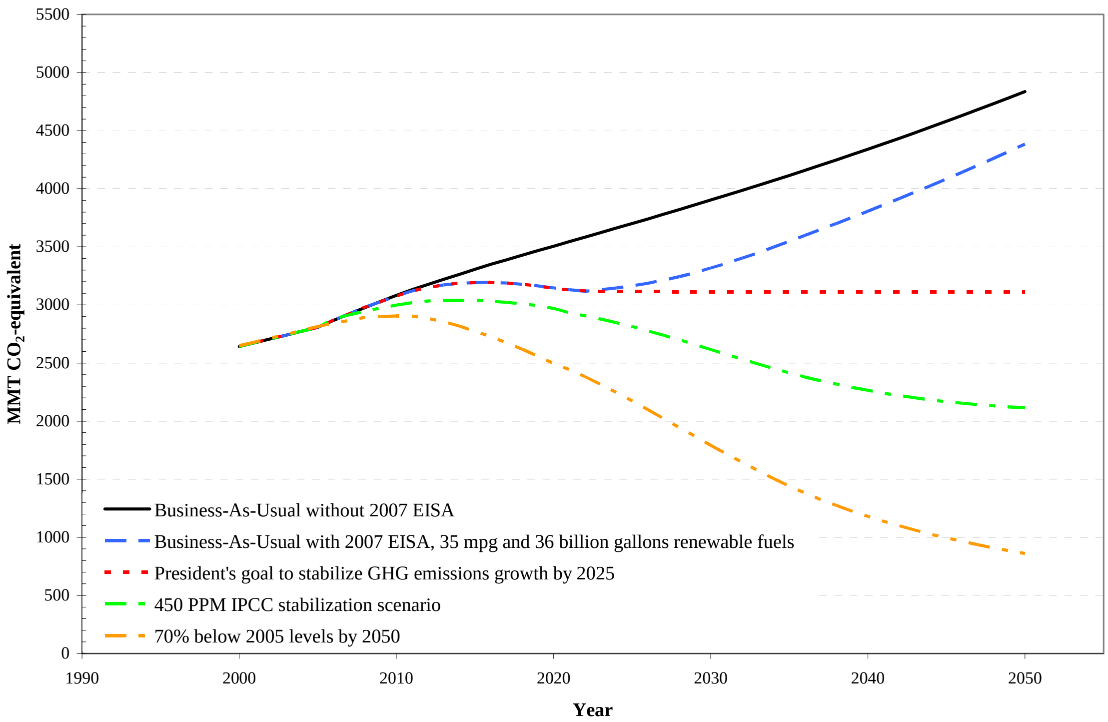
[120] Prior to the passage of EISA, an EPA analysis projected that, absent additional regulatory approaches, transportation would provide about one-tenth of the GHG emission reductions that would be required to comply with an emissions cap based on a 70% reduction from 2005 levels in 2050, even though transportation is responsible for 28% of the official U.S. GHG emissions inventory.

reductions that would be needed for mobile sources to make a proportional contribution to meeting the President's climate goal by 2050 (Figure VI-4, third curve), the IPCC 450 CO_2 ppm stabilization scenario in 2050 (Figure VI-4, fourth curve), and a 70% reduction in 2005 levels in 2050 (Figure VI-4, bottom curve), respectively.[121] These curves shed light on the possible additional role the transportation sector could play in achieving reductions, but do not address whether such reductions would be cost effective compared to other sectors. Title II regulation of GHG emissions could conceivably achieve greater emissions reductions so that mobile sources would make a larger contribution to meeting these targets. EPA requests comment on the usefulness of the information provided in Figure VI-4 and on approaches for determining what additional mobile source GHG emissions reductions would be appropriate. As described later in this section, our assessment of available and developing mobile source technologies for reducing GHG emissions indicates that mobile sources could feasibly achieve significant additional reductions.

[121] Calculation of the GHG emission reductions that EISA's fuel economy provisions will achieve include standards that result in an industry-wide fleet average fuel economy of 35 miles per gallon by 2020.

Figure VI-4

U.S. Transportation GHG Emissions Projections and Illustrative Targets Based on Proportional Reductions



4. Potential Approaches for Using Clean Air Act Title II to Reduce Mobile Source GHG Emissions

The regulatory approach and principles that guided development of our current mobile source emissions control program may prove useful in considering a possible mobile source GHG emissions control strategy under Title II of the CAA. As explained above, under Title II, EPA could potentially apply its historical approach for regulating traditional tailpipe emissions to long-term mobile source GHG emissions control, with the aim of providing strong incentives for technological innovation. The Agency invites public comment on the principles and underlying legal authority it has applied in the past and other possible principles for establishing GHG emissions standards under Title II, including –

- Coverage of all key vehicle, engine, and equipment sub-sectors in the entire transportation sector so that GHG emission standards are set not only for cars and light trucks, but for heavy-duty vehicles, non-road engines and equipment, including locomotive and marine engines, and aircraft as well. This broader regulatory coverage would provide more comprehensive mobile source GHG emissions reductions and market incentives to seek the most cost-effective solutions within the sector.
- Coverage of all GHGs emitted by the transportation sector by setting emissions standards that address every GHG for which the Agency makes the appropriate cause or contribute endangerment finding.

- Inclusion of transportation fuels in the program by considering vehicles and fuels as a system, rather than as isolated components.
- Addressing transportation fuels by setting GHG standards that account for the complete lifecycle of GHG emissions, including upstream GHG emissions associated with transportation fuel production. [122]
- Identifying long-term U.S. mobile source GHG emissions targets based on scientific assessments of environmental need, and basing the stringency of standards for individual mobile source sub-sectors on technology feasibility, cost and fuel savings, taking into account the relationship of mobile source reductions to reductions in other sectors under any economy-wide program.
- Allowing for staggered rulemakings for various sub-sectors and fuels, rather than regulating all mobile source entities at one time. EPA seeks comment on its CAA authority in this area, as well as on an approach to base the timing of the staggered rulemakings on factors such as the contribution of the mobile source sub-sector to the overall GHG emissions inventory and the lead time necessary for the commercialization of innovative technology.
- Use of Title II statutory authority to adopt technology-forcing standards, when appropriate, in conjunction with periodic reviews of technology and other key analytical inputs as a "reality check" to determine whether mid-course corrections in GHG emissions standards are needed.
- Use of our statutory authority to increase the rate of emissions reduction targets over time while allowing sufficient time for entrepreneurs and

[122] EPA invites comment on how such an approach would interact with GHG regulations under other parts of the CAA or with a possible economy-wide approach.

engineers to develop cost-effective technological solutions and minimize the risk of early retirement of capital investments.

- Establishment of a flexible compliance program that would allow averaging, banking and borrowing, and credit trading. Existing Title II programs generally allow credit trading only within individual mobile source sub-sector programs. EPA solicits comments on whether the global nature of climate change supports allowing credit trading between obligated parties across all mobile source sub-sectors and whether this would allow the sector as a whole to seek the lowest-cost solutions.
- Design of enforcement programs to ensure real world emissions reductions over the life of vehicles, engines, and equipment.
- Providing sufficient flexibility so that mobile source GHG emissions control programs can complement and harmonize with existing regulatory programs for certain pollutants.

In developing potential approaches to design of a Title II program, it is critical for EPA to understand the full ramifications of advanced technologies. Accordingly, EPA seeks public comment on potential GHG reducing technologies and their impacts, including availability, practicality, emissions reduction potential, cost, performance, reliability, and durability. EPA also seeks comment on how best to balance factors such as the need to send effective long-term signals that stimulate technology innovation, the imprecision of predictions of future technology innovation, and the importance of lead time to allow orderly investment cycles.

While advanced technology for reducing GHGs would likely increase the initial cost of vehicles and equipment to consumers and businesses, it would also increase efficiency and reduce fuel costs. In many cases, there is the potential for the efficiency advantages of low-GHG technologies to offset or more than offset the higher initial technology cost over the lifetime of the vehicle or equipment. EPA recognizes that not all consumers may understand or value changes to vehicles that reduce GHG emissions by increasing fuel efficiency, even though these changes lower fuel costs (see discussion in Section VI.C.2). One analytic issue that has policy implications is the most appropriate method for treating future consumer fuel savings when calculating cost effectiveness for a mobile sources GHG control strategy. Some analyses that consider the decisions made by automakers in isolation from the market and consumers exclude future fuel savings entirely. A second approach, used in models trying to predict future consumer behavior based on past experience, counts only those future fuel savings which consumers implicitly value in their new vehicle purchase decisions. A third method, reflecting a societal-wide accounting of benefits, includes all future fuel savings over vehicle lifetimes, whether overtly valued by new vehicle purchasers or not. EPA seeks comments on what could be done under Title II, or under any new legislation to complement Title II, to establish economic incentives that send long-term market signals to consumers and manufacturers that would help spark development of and investment in the necessary technology innovation.

An effective mobile source emissions compliance and enforcement program is fundamental to ensuring that the environmental benefits of the emission standards are achieved. We request comments on all aspects of the compliance approaches discussed in this notice and any other approaches to a compliance program for mobile source GHG emissions control. Topics to address could include, but are not limited to, methods for classifying, grouping and testing vehicles for certification, useful life and component durability demonstration, in-use testing, warranty and tampering, prohibited acts, and flexibilities for manufacturers.

Historically, EPA's programs to reduce criteria pollutants have typically included provisions to allow the generation, averaging, banking, and trading of emission credits within a vehicle or engine category. For example, there are averaging, banking, and trading (ABT) programs for light-duty vehicles, heavy-duty engines, and nonroad engines, among others. In these programs, manufacturers with vehicles or engines designed to over-comply with the standards can generate credits. These credits can then be used by that manufacturer or sold to other manufacturers in order to allow similar vehicles or engines with emissions above the standards to be certified and sold.

However, for a variety of reasons, we have in most cases not provided for trading of emission credits from one mobile source category to another. For example, credits generated in the light-duty vehicle program cannot be used for heavy-duty engines to comply, or credits generated for lawn and garden equipment cannot be used for larger gasoline engines to comply. These limitations are generally grounded in characteristics of required pollutants that do not necessarily apply in the case of GHG emissions. For instance, in the case of hydrocarbon emissions, because our programs are meant, in part, to reduce the pollutant in areas where it most contributes to ozone formation, we have not allowed farm tractors in rural areas to generate credits that would allow urban passenger cars to be sold with little or no emission control. Similarly, for problems like carbon monoxide “hot spots” or direct, personal exposure to diesel PM, it has been important to ensure a certain minimum degree of control from each vehicle or engine, rather than allowing the very localized benefits to be “traded away.”

Given the global nature of the major GHGs, we request comment on whether new provisions could be used to allow broad trading of CO_2-equivalent emission credits among the full range of mobile sources, and if so, how they could be designed, including highway and nonroad vehicles and engines as well as mobile source fuels.

EPA has also considered the potential of GHG emissions leakage to other domestic economic sectors, or to other countries, should EPA adopt Title II standards for motor vehicle GHG emissions and GHG emissions from transportation fuels. As discussed in more detail later in this section, there are transportation fuels (such as grid electricity) that do not result in tailpipe GHG emissions, but that do result in GHG emissions when the fuel is produced. Greater use of such fuels in transportation would reduce GHG emissions covered by Title II, but would increase GHG emissions covered by Title I, requiring coordination among the CAA programs to ensure the desired level of overall GHG control. In addition, GHG emissions from potential land use changes caused by transportation fuel changes could cause GHG emissions leakage unless accounted for in any transportation fuels GHG program. Finally, since transportation fuels can be fungible commodities, if other countries do not adopt similar GHG control programs, it is possible that lower-lifecycle GHG fuels will be concentrated in the U.S. market, while higher-lifecycle GHG fuels will be concentrated in unregulated markets. For example, sugar cane-based ethanol, if it were determined to have more favorable upstream GHG emissions, could shift from the Brazilian to the U.S. market, and corn-based ethanol, if it were determined to have less favorable upstream GHG emissions, could shift from the U.S. to the Brazilian market. This shifting could ease compliance with U.S. transportation fuel GHG regulations, but could actually increase global GHG emissions due to the GHG emissions that would result from transporting both types of ethanol fuels over greater distances. EPA seeks comments on all possible GHG emissions leakage issues associated with mobile source GHG regulation, and in particular on whether the theoretical concern with fungible transportation fuels is likely to be realized.

While the preceding discussion has focused on using the existing CAA Title II model for regulating mobile source GHG emissions, there are other alternative regulatory approaches on which EPA invites comments. In particular, long-term mobile source GHG emissions reductions from vehicles and equipment might be achieved by establishing GHG emissions caps on vehicle, engine, and/or equipment manufacturers to the extent authorized by the CAA. EPA's existing regulatory program uses performance standards that are rate-based, meaning that they require manufacturers to meet a certain gram/mile average for their fleet, as in the Tier 2 light-duty vehicle program. Manufacturers produce vehicles with varying rates of emissions performance, and through averaging, banking, and trading demonstrate compliance with this performance standard on a sales-weighted average basis. While a manufacturer must take its fleet mix of higher-emitting and lower-emitting models into account in demonstrating compliance, the sales-weighted average is independent of overall sales as long as the fleet mix does not change. As a result, a manufacturer's fleet may emit more or less total pollution depending on its total sales, so long as the sales-weighted average emissions of its vehicles do not exceed the standard.

In a cap-and-trade program, the standard set by EPA would not be an average, sales-weighted rate of emissions, but rather a cap on overall emissions from a manufacturer's production. Under such a program, the emissions attributable to a manufacturer's fleet could not grow with sales unless the manufacturer obtained (e.g., through trading) additional allowances to cover higher emissions. Presumably, EPA could assign a VMT or usage value to be used by manufacturers, and manufacturers would demonstrate compliance by combining the rate of performance of their vehicles, their sales volume, and the assigned VMT or usage value to determine overall emissions.

EPA could set standards under an emissions cap-and trade program by assessing the same kind of factors as we have in the past: availability and effectiveness of technology, cost, safety, energy factors, etc. Setting an appropriate emissions cap would be more complex, and EPA would need to demonstrate that the cap is appropriate, given that changes in sales levels (both industry-wide and for individual manufacturers) must be accounted for in the standard-setting process. An emissions cap approach also raises difficult issues of how allowable emissions under the cap would be allocated among the manufacturers, including new entrants.

EPA invites comment on all issues involving this emissions cap-and-trade approach, including comment on relevant technical and policy issues, and on EPA's authority to adopt such an approach under Title II.

A third possible model for regulating mobile source GHG emissions would combine elements of these approaches. This type of hybrid approach would include, as one element, either rate-based GHG emissions performance standards similar to the existing mobile source program for conventional pollutants or GHG emissions caps for key vehicle, engine, and/or equipment manufacturers, both of which would be promulgated under Title II of the CAA. The second element of this hybrid approach would be an upstream emissions cap on fuel refiners for all life-cycle GHG emissions associated with transportation fuels, including both upstream fuel production GHG emissions and downstream vehicle GHG emissions, to the extent authorized under the CAA or future climate change legislation. For a discussion of issues associated with including direct mobile source obligations in combination with an economy-wide approach, see section III.F.3.

An important interrelationship between stationary sources and mobile sources would develop if grid electricity becomes a more prevalent transportation fuel in the future. There is considerable interest, both by consumers and automakers, in the possible development and commercialization of plug-in hybrid electric vehicles (PHEVs) that would use electricity from the grid as one of two sources of energy for vehicle propulsion. Use of grid electricity would yield zero vehicle tailpipe GHG emissions, providing automakers with a major incentive to consider PHEVs, which may be appropriate given that vehicle cost is the single biggest market barrier to PHEV commercialization. But it would also result in a net increase in demand for electricity, which could add to the challenge of reducing GHG emissions from the power sector. Any evaluation of the overall merits of using grid electricity as a transportation fuel could not be done in isolation, but would require a coordinated assessment and approach involving both mobile sources under CAA Title II and stationary sources under CAA

Title I. Linking efforts under Titles I and II would allow for needed coordination regarding any type of future transportation fuel that would have zero vehicle tailpipe GHG emissions but significant fuel production GHG emissions.

EPA seeks comment on all aspects, including the advantages and disadvantages, of using Title II regulations to complement an economy-wide cap-and-trade GHG emissions program.

EPA also seeks public comment on the available authority for, and the merits of, allowing credit trading between mobile sources and non-mobile source sectors. One of the potential limitations of allowing credit trading only within the transportation sector is that it would not permit firms to take advantage of emission reduction opportunities available elsewhere in the economy. In particular, EPA requests comment on the advantages and disadvantages of allowing trading across sectors, and how to ensure that credit trading would have environmental integrity and that credits are real and permanent.

Finally, EPA seeks public comment on two remaining issues: (1) how a CAA Title II mobile source GHG emissions control program and NHTSA's corporate average fuel economy program for cars and light-duty trucks could best be coordinated; and (2) whether and how Title II, or other provisions in the CAA, could be used to promote lower vehicle miles traveled and equipment activity.

B. On-Highway Mobile Sources

1. Passenger Cars and Light-Duty Trucks

In this section, we discuss and request comment on several potential approaches for establishing light-duty vehicle GHG emission standards under section 202(a)(1). These approaches build off of, to varying extents, the analysis EPA undertook during 2007 to support the development of a near-term control program for GHG emissions for passenger cars and light duty trucks under the authorities of Title II of the CAA.

We begin this section with a discussion of one potential approach for establishing GHG standards under section 202(a) of the CAA that reflects EPA's historical approach used for traditional pollutants, including the principles EPA has used in the past under Title II. This approach focuses on long-term standard setting based on the technology-forcing authority provided under Title II. Next we present and discuss the results of alternative approaches to standard-setting which EPA considered during 2007 in the work performed under EO 13432. This alternative approach is based on setting near-term standards based primarily on technology already in the market today. This is followed by a discussion of the wide range of technologies available today and technologies that we project will be available in the future to reduce GHG emissions from light-duty vehicles. We next include a discussion of a potential approach to reduce HFC, methane, N_2O, and vehicle air conditioning-related CO_2 emissions. We conclude with a discussion of the key implementation issues EPA has considered for the development of a potential light-duty vehicle GHG control program.

Our work to date indicates that there are significant reductions of GHG emissions that could be achieved for passenger cars and light-duty trucks up to 2020 and beyond that would result in large net monetized benefits to society. For example, taking into account specific vehicle technologies that are likely to be available in that time period and other factors relevant to motor vehicle standard-setting under the CAA, EPA's analysis suggests that substantial reductions can occur where the cost-per-ton of GHG reduced is more than offset by the value of fuel savings, and the net present value to society could be on the order of $340 to $830 billion without considering benefits of GHG reductions (see section VI.B.1.b).[123]

a. Traditional Approach to Setting Light-Duty Vehicle GHG Standards

In this section we discuss and request comment on employing EPA's traditional approach to setting mobile source emissions standards to develop standards aimed at ensuring continued, long-term, technology-based GHG reductions from light-duty vehicles, in light of the unique properties of GHG emissions. We also request comment on how EPA could otherwise use its CAA Title II authorities to provide incentives to the market to accelerate the development and introduction of ultra clean, low GHG emissions technologies.

Based on our work to date, we expect that such an approach could result in standards for the 2020 to 2025 time frame that reflect a majority of the new light-duty fleet achieving emission reductions based on what could be accomplished by many of the most advanced technologies we know of today (e.g., hybrids, diesels, plug-in hybrid vehicles, full electric vehicles, and fuel cell vehicles, all with significant use of light-weight materials). Our analysis (presented in section VI.B.1.b) indicates that standards below 250 g/mile CO2 (above 35 mpg) could be achievable in this time frame, and the

[123] These estimates do not account for the future CAFE standards that will be established under EISA.

net benefit to society could be in excess of $800 billion. These estimates, however, do not account for future CAFE standards that will be established under EISA.

EPA's historical approach for setting air pollutant standards for mobile sources has been to assess the capabilities of pollution control technologies, including advanced control technologies; whether reductions associated with these technologies are feasible considering cost, safety, energy, and other relevant factors; and the benefits of these controls in light of overall public health and environmental goals. Public health and environmental goals provide the important context in which this technology-driven process occurs. In many cases in the past, the goals have involved the need for emissions reductions to attain and maintain NAAQS.

As mentioned previously, EPA has utilized the CAA to establish mobile source programs which apply progressively more stringent standards over many years, often with substantial lead time to maximize the potential for technology innovation, and where appropriate, we have included technology reviews along the way to allow for "mid-course corrections," if needed. We have also provided incentives for manufacturers to develop and introduce low emission technologies more quickly than required by the standards. For example, in our most recent highway heavy-duty engine standards for PM and NOx, we established technology-forcing standards via a rulemaking completed in 2000 which provided six years of lead-time for the start of the program and nearly ten years of lead-time for the completion of the phase-in of the standards. In addition, EPA performed periodic technology reviews to ensure industry was on target to comply with the new standards, and these reviews allowed EPA to adjust the program if necessary. This same program provided early incentive emission credits for manufacturers who introduced products complying with the standards well in advance of the program requirements.

Consistent with the CAA and with our existing mobile source programs, we request comment on using the following traditional principles for development of long-term GHG standards for light-duty vehicles: technology-forcing standards, sufficient lead-time (including phase-in of standards reflecting use of more advanced technologies), continual improvements in the rate of emissions reduction, appropriate consideration of the costs and benefits of new standards, and the use of flexible mechanisms such as banking and credit trading (between sources within or outside of this sector). EPA's goal would be to determine the appropriate level of GHG emission standards to require by an appropriate point in the future. We would establish the future time frame in light of the needs of the program. EPA would evaluate a broad range of technologies in order to determine what is feasible and appropriate in the time frame chosen, when considering the fleet as a whole. EPA would analyze the costs and reductions associated with the technologies, and compare those to the benefits from and the need for such reductions. We would determine what reductions are appropriate to require in that time frame, assuming industry started now, and then determine what appropriate interim standards should be set to most effectively move to this long-term result.

In developing long-term standards, we would consider known and projected technologies which in some cases are in the market in limited production or which may not yet be in the market but which we project can be, provided sufficient lead-time. We would consider how broadly and how rapidly specific technologies could be applied across the industry. If appropriate, EPA could include technology reviews during the implementation of new standards to review the industry's progress and to make adjustments as necessary. EPA would evaluate the amount of lead-time necessary and if appropriate the phase-in period for long-term standards. To the extent that future standards may result in significant increases in advanced technologies such as plug-in electric hybrid or full electric vehicles, we would consider how a Title II program might interact with a potential Title I program to ensure that reductions in GHG emissions due to a decrease in gasoline consumption are not off-set by increases in GHG emissions from the electric utility sector. We would also consider the need for flexibilities and incentives to promote technology innovation and provide incentives for advanced technologies to be developed and brought to the market. We would consider the need for orderly manufacturer production planning to ensure that capital investments are wisely used and not stranded. Finally, EPA would evaluate the near and long-term costs and benefits of future standards in order to ensure the appropriate relationship between benefits and costs, e.g. ensuring that benefits of any future standards exceed the costs. This could lead to standard phase-in schedules significantly different from the two approaches contained in our Light-duty Vehicle Technical Support Document analysis (available in the docket for this advance notice); which under one approach was the same incremental increase in stringency each year (the 4% per year approach), and for the second approach lead to large increases in stringency the first several years followed by small changes in the later years (the model-optimized approach).

One critical element in this approach is the time frame over which we should consider new GHG standards for light-duty vehicles. We request comment on the advantages and disadvantages of establishing standards for the 2020 or 2025 time frame, which is roughly consistent with EPA's traditional approach to setting standards while allowing a sufficient time period for investment and technological change, and even longer. There are two major factors which may support a long-term approach. First, addressing climate change will require on-going reductions from the transportation sector for the foreseeable future. Thus, establishing short-term goals will not provide the long-term road map which the environmental problem requires. Second, providing a long-term road map could have substantial benefits for the private sector. The automotive industry itself is very capital intensive – the costs for developing and producing a major vehicle model is on the order of several billion dollars. A manufacturer making a major investment to build a new engine, transmission or vehicle production plant expects to continue to use such a facility without major additional investments for at least 15 years, if not more. A regulatory approach which provides a long-term road map could allow the automotive industry to plan their future investments in an orderly manner and minimize the potential for stranded capital investment, thus helping to ensure the most efficient use of societal resources. A long-term regulatory program could also provide industry with the regulatory certainty necessary to stimulate technology development, and help ensure that the billions of dollars invested in technology research and development are focused on long-term needs, rather than on short-term targets alone.

There could also be disadvantages to establishing long-term standards. For example, uncertainties in the original analysis underlying the long-term standards could result in overly conservative or optimistic assumptions about emission reductions could and should be accomplished. Long-terms standards could also reduce flexibility to respond to more immediate market changes or other unforeseen events. EPA has tools, such as technology reviews, that could help reduce these risks of long-term standards. We request comment on the advantages and disadvantages of a long-term approach to standard-setting, and any issues it might raise for integration with an economy-wide approach to emission reductions.

More generally, EPA requests comment on the issues discussed in this section, and specifically the appropriateness of a light-duty vehicle GHG regulatory approach in which EPA would identify long-term emissions targets (e.g., the 2020-2025 time frame or longer) based on scientific assessments of environmental need, and developing standards based on a technology-forcing approach with appropriate consideration for lead-time, costs and societal benefits.

b. 2007 Approach to Setting Light-Duty Vehicle Emission Standards

i. CAA and EPCA authority; passage of EISA

As indicated above in section VI.A.2, CAA section 202(a) provides broad authority to regulate light-duty vehicles. Standards which EPA promulgates under this authority are technology-based and applicable for the useful life of a vehicle. EPA has discretion to consider and weigh various additional factors, including the cost of compliance, safety and other impacts on consumers, and energy impacts.

NHTSA authority to set CAFE standards derives from the Energy Policy and Conservation Act (42 USC section 6201 et seq.) as amended by EISA. This statutory authority, enacted in December 2007, directs NHTSA to consider four factors in determining maximum feasible fuel economy standards -- technological feasibility, economic practicability, the effect of other standards issued by the government on fuel economy, and the need of the nation to conserve energy. NHTSA may also take into account other relevant considerations such as safety.

EISA amends NHTSA's fuel economy standard-setting authority in several ways. Specifically it replaces the statutory default standard of 27.5 miles per gallon for passenger cars with a mandate to establish separate passenger cars and light truck standards annually beginning in model year 2011 to reflect the maximum feasible level. It also requires that standards for model years 2011-2020 be set sufficiently high to ensure that the average fuel economy of the combined industry-wide fleet of all new passenger cars and light trucks sold in the U.S. during MY 2020 is at least 35 miles per gallon. In addition, EISA provides that fuel economy standards for no more than five model years be established in a single rulemaking, and mandated the reform of CAFE standards for passenger cars by requiring that all CAFE standards be based on one or more vehicle attributes, among other changes.[124] EISA also directs NHTSA to consult with EPA and the Department of Energy on its new CAFE regulations.

Pursuant to EISA's amendments to EPCA, NHTSA recently issued a notice of proposed rulemaking for new, more stringent CAFE standards for model years 2011-2015 for both passenger cars and light-duty trucks. 73 FR 24352 (May 2, 2008).

Prior to EISA's enactment, EPA and NHTSA had coordinated under EO 13432 on the development of CAA rules that would achieve large GHG emission reductions and CAFE rules that would achieve large improvements in fuel economy. As discussed later

[124] For a full discussion of EISA requirements and NHTSA interpretation of its statutory authority please see 73 FR 24352 (May 2, 2008).

in this section, there are important differences in the two agencies' relevant statutory authorities. EPA nevertheless believes that it is important that any future GHG regulations under CAA Title II and future fuel economy regulations under NHTSA's statutory authority be designed to ensure that an automaker's actions to comply with CAA standards not interfere with or impede actions taken for meeting fuel economy standards and vice versa. The goals of oil savings and GHG emissions reductions are often closely correlated, but they are not the same. As the Supreme Court pointed out in its Massachusetts decision, "[EPA's] statutory obligation is wholly independent of DOT's mandate to promote energy efficiency", and "[t]he two obligations may overlap, but there is no reason to think the two agencies cannot both administer their obligations and yet avoid inconsistency." It is thus important for EPA and NHTSA to maximize coordination between their programs so that both the appropriate degree of GHG emissions reductions and oil savings are cost-effectively achieved, given the agencies' respective statutory authorities. EPA asks for comment on how EPA's and NHTSA's respective statutory authorities can best be coordinated under all of the alternatives presented in this section so that inconsistency can be avoided.

ii. 2007 approach

In this section, we present an overview of two alternative approaches for setting potential light-duty vehicle GHG standards based on our work during 2007 under EO 13432. As noted previously, in response to Massachusetts v. EPA and as required by EO 13432, prior to EISA's passage, we coordinated with NHTSA and the Department of

Energy in developing approaches and options for a comprehensive near-term program under the CAA to reduce GHG emissions from cars and light-duty trucks.[125] Results from this effort are discussed below and in a Technical Support Document, “Evaluating Potential GHG Reduction Programs for Light Vehicles” (referred to as the “Light-duty Vehicle TSD” in the remainder of this notice).

The Light-duty Vehicle TSD represents EPA’s assessment during 2007 of how a light-duty vehicle program for GHG emissions reduction under the CAA might be designed and implemented in keeping with program parameters (e.g., time frame, program structure, and analytical tools) developed with NHTSA prior to enactment of EISA. In addition, the Light-duty Vehicle TSD assesses the magnitude of the contribution of light-duty vehicles to U.S. GHG emissions. It also addresses both tailpipe CO_2 emissions as measured by EPA tests used for purposes of determining compliance with CAFE standards, and control of other vehicular GHG emissions. These other emissions are not accounted for if the regulatory focus is solely on CO_2, and involve greenhouse gases that have higher global warming potentials than CO_2. These emissions, as well as air-conditioning-related CO_2, are not measured by the existing EPA test procedure for determining compliance with CAFE standards, so that there is no overlap with control of these emissions and CAFE standards if these emissions are controlled under the CAA. As described in the section VI.B.1.d of this advance notice, these emissions account for 10 percent of light-duty vehicle GHG emissions on a CO_2 equivalent basis. They include emissions of CO_2 from air conditioning use and emissions of HFCs from air conditioning system leaks. Technologies exist which can reduce these

[125] E.O. 13432 called on the agencies to, “undertake such regulatory action, to the maximum extent permitted by law and determined by the head of the agency to be practicable, jointly with other agencies.”

emissions on the order of 40 to 75% (for air conditioning efficiency improvements and HFC leakage control respectively), at an initial cost to the consumer of less than $110. This initial cost would be more than offset by the reduced maintenance and fuel savings due to the new technology over the life of the vehicle. We also considered standards which would prevent future increases in N_2O and methane.

Based on our work in 2007 pursuant to Executive Order 13432, EPA developed two different analytical approaches which could be pursued under the CAA for establishing light-duty vehicle CO_2 standards. Both are attribute-based approaches, using vehicle footprint (correlating roughly to vehicle size) as the attribute. Under either approach, a CO_2-footprint continuous function curve is defined that establishes different CO_2 emission targets for each unique vehicle footprint. In general, the larger the vehicle footprint, the higher (less stringent) the corresponding vehicle CO_2 emission target will be. Each manufacturer would have a different overall fleet average CO_2 emissions standard depending on the distribution of footprint values for the vehicles it sells. See Section VI.B.1.d and the Light-duty Vehicle TSD of this Advance Notice for additional discussion of attribute-based standards and other approaches (e.g., a non-attribute, or universal standard).

One approach was based on a fixed percentage reduction per year in CO_2 emissions. We examined a 4% per year reduction in CO_2 emissions, reflecting the projected reductions envisioned by the President in his 20-in-10 plan in the 2007 State of the Union address and subsequent legislative proposals . The other approach identified CO_2 standards which an engineering optimization model projects as resulting in maximum net benefits for society (hereafter referred to as the "model-optimized" approach). That approach uses a computer model developed by the Department of Transportation Volpe Center called the CAFE Effects and Compliance Model (the "Volpe Model"). The Volpe Model was designed by DOT as an analytical tool which could evaluate potential changes in the stringency and structure of the CAFE program, and was first used in DOT's 2006 rulemaking establishing CAFE standards for model years 2008 – 2011 light-trucks.[126,127]

Using the fixed percentage reduction approach, projections regarding technology feasibility, technology effectiveness, and lead-time are critical as these are the most important factors in determining whether and how the emission reductions required by a future standard would be achieved. When using the model-optimized approach, a larger set of inputs are critical, as each of these inputs can have a significant impact in the model's projections as to the future standard. These inputs include technology costs and effectiveness, lead-time, appropriate discount rates, future fuel prices, and the valuation of a number of externalities (e.g., criteria air pollution improvements, GHG emission reductions, and energy security). Although all of these factors are relevant under either approach, there are major differences in the way this information is used in each approach to develop and evaluate appropriate standards.

EPA believes both of these approaches for establishing fleet-wide average CO_2 emissions standards are permissible, conceptually, under section 202(a) of the Act. Section 202(a)(2) requires EPA to give consideration to "the cost of compliance" for use of the technology projected to be used to achieve the standards ("requisite technology"). The model-optimized approach can be used in appropriate circumstances to satisfy this

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[126] See 66 FR 17566 - Average Fuel Economy Standards for Light Trucks Model Years 2008-2011.
[127] See "CAFE Compliance and Effects Modeling System Documentation, Draft, 1/26/07" published by DOT, a copy of which is available in the docket for this Advanced Notice.

requirement.[128] The fixed percent per year approach is broadly consistent with EPA's traditional means of setting standards for mobile sources, which identifies levels of emissions reductions that are technologically feasible at reasonable cost with marginal emissions reduction benefits which may far outweigh marginal program costs, without adverse impacts on safety and with positive impacts on energy utilization, and which address a societal need for reductions.[129] Comparing and contrasting these approaches with the model-optimized approach is one way to evaluate options for appropriate standards under section 202(a). We request comment on these approaches and whether one or the other is a more appropriate method for EPA to consider future light-duty GHG standards under section 202 of the CAA. We also request comment on other potential approaches EPA should consider, including the approach described in section VI.B.1.a.

During 2007, EPA, DOT's Volpe Center, and NHTSA expended a major technical effort to make a series of significant enhancements to the Volpe Model by reviewing and updating, where possible, many of the critical inputs to the Model (e.g., cost reduction learning curves, the number and estimated costs and effectiveness of potential CO_2/mpg control technologies), as well as making updates to the Model itself. This technical work notably improved the Volpe Model. However, the Volpe Model was designed specifically to analyze potential changes to NHTSA's CAFE program, and there remained several aspects of the analysis we conducted that did not reflect differences between EPA and NHTSA statutory authorities, and we were not able to address these aspects in 2007. As a result, our analysis tended to underestimate the benefits and/or

[128] See Husqvarna AB v. EPA, 254 F. 3d 195, 200 (D.C. Cir. 2001) (EPA reasonably chose not to use marginal cost-benefit analysis to analyze standards [under the technology-forcing section 213 of the Act], where section 213 does not mandate a specific method of cost analysis).
[129] See NRDC v. EPA, 655 F. 2d 318, 332-334 (D.C. Cir. 1981).

overestimate the costs of light-duty vehicle CO2 standards that could be established under the CAA. We discuss these issues below.

First, past NHTSA CAFE regulatory actions have generally had a short term focus (a 3-5 year timeframe), and NHTSA is currently proposing more stringent CAFE standards for five model years, 2011-2015, in keeping with is revised statutory authority, as discussed above. In contrast, EPA's Title II authority permits EPA to set standards over a significantly longer period of time as appropriate in light of environmental goals, developing technologies, costs, and other factors. A short-term focus can have a significant implication for the technology assumptions which go into a standard-setting analysis.

In our 2007 analysis, we assumed limited technology innovation beyond what is known today, and did not include several commercially available or promising technologies such as advanced lightweight materials for all vehicle classes (several auto companies have recently announced plans for large future reductions in vehicle weight), plug-in hybrids, optimized ethanol vehicles, and electric vehicles. To the extent such innovations penetrate the market over the next 10 years, the societal benefits and/or decreased societal cost of CO_2 standards will be greater than what we projected. A short-term focus may yield a more reliable short term projection because it relies on available technology and is less prone to uncertainties involved in projecting technological developments and other variables over a longer term. The trade-off is that such a focus may not stimulate the development of advanced, low GHG-emitting technologies. For the auto industry, significant technological advances have historically required many years and large amounts of capital.

Second, our 2007 analysis does not account for a series of flexibilities that EPA may employ under the CAA to reduce compliance costs, such as multi-year strategic planning, and credit trading and banking. As mentioned previously, EPA has used many of these flexibilities in its existing mobile source programs, and we would attempt to include such flexibilities in any future EPA GHG standards analysis.

Third, under the CAA manufacturers traditionally choose to comply instead of non-comply, since they cannot sell new vehicles unless they receive a certificate of conformity from EPA that is based on a demonstration of compliance. Under the penalty provisions of the CAA, light-duty vehicle manufacturers may not pay a civil penalty or a fine for non-compliance with the standards and still introduce their vehicles into commerce. In our 2007 analysis, we assumed a number of manufacturers would pay fees rather than comply with the analyzed standards. This assumption resulted in a lower compliance cost estimation and lower GHG benefits.

Fourth, in our 2007 analysis, we did not reflect the difference in carbon content between gasoline and diesel fuel. This difference has not been germane to NHTSA's setting of CAFE standards, but it is important to the GHG emissions reductions that different standards can achieve. Therefore, our Light-duty Vehicle TSD analysis did not account for the higher CO_2 emissions which result from the use of a gallon of diesel fuel compared to a gallon of gasoline (diesel fuel has a higher carbon content than gasoline fuel), and we would address this issue in any future EPA GHG standards analysis.

As noted previously, our 2007 analysis relied upon the use of key inputs concerning predictions of future technologies and fuel prices and valuation of a number of externalities, such as the benefits of climate change mitigation and improvements in energy security. The information used for these key inputs can have a significant effect on projections regarding the costs of a standard based on a fixed percentage reduction or the level of a model-optimized standard. In the analyses we present in this notice, we have generally taken an approach similar to NHTSA's, although we have also used alternative values in some cases to illustrate the impact from different, alternative values. For example, to account for large uncertainties regarding the magnitude of the marginal benefits of GHG emission reductions, we looked at alternative approaches to valuing those benefits and developed a range of values to capture the uncertainties. (See section III.G in this ANPR for a discussion of GHG benefits issues and marginal benefits estimates.)

Another key, but uncertain, input is the future price of fuel. Important for any analysis of fuel savings over a long time frame is an adequate projection of future oil prices. Typically, EPA relies on Annual Energy Outlook (AEO) forecasts made by the Energy Information Agency. However, AEO forecasts in past decades have at times over-predicted the price of oil, and more recently, with the rapid increase in oil prices over the past several years, AEO forecasts have consistently under-predicted near-term oil prices. In the Light-duty Vehicle TSD analysis, we used the Energy Information Administration's 2007 AEO projections for future oil and fuel prices, which correspond to a projected retail gasoline price of slightly more than $2 per gallon in the 2010-2020 time period, while current gasoline fuel prices are on the order of $3.50 to $3.80 per gallon or more. Since our analyses are sensitive to the oil price used, this raised concerns regarding the ability to accurately estimate fuel savings. In addition, when using a model-optimized approach, this can have a significant impact on the appropriate standard predicted by the model. For our updated analysis (described in more detail below), however, we have continued to use the AEO2007 forecasted fuel prices. The "baseline" for our Light-duty Vehicle TSD and updated analysis reflects projections from the automotive manufacturers regarding future product offerings which were developed by the manufacturers in late 2006 through the spring of 2007. The AEO2007 fuel price projections are more representative of the fuel prices considered by the manufacturers when they developed the baseline future product offerings used as an input in the analysis.

This approach has certain limitations. Given the large increases in fuel price in the past year, most major automotive companies have since announced major changes to their future product offerings, and these changes are not represented in our analysis. However, the projection of future product offerings (model mix and sales volume) is static in the analysis we have performed, both for the baseline (projections with no new standards) and in the control scenarios (projections with the impact of new standards). Our analysis to date does not account for a range of possible consumer and automaker responses to higher fuel prices, higher vehicle prices and attribute-based standards that could affect manufacturer market share, car/truck market share, or vehicle model mix changes. EPA has initiated work with Resources for the Future to develop a consumer choice economic model which may allow us to examine the impact of consumer choice and varying fuel prices when analyzing potential standard scenarios in the future, and to more realistically estimate a future baseline. Higher fuel prices than those predicted in AEO2007 can certainly have a large impact on the projected costs and benefits of future light-duty GHG limits, and we will continue to examine this issue as part of our on-going work.

We ask for comment on the relative importance of, and how best to address, the various issues we have highlighted with our analysis of potential light-duty vehicle GHG standards performed to date. In particular, we seek comment on the feasibility and utility of incorporating into the regulations themselves a mechanism for correcting mistaken future projections or accomplishing the same through a periodic review of the regulations.

We now summarize the results from our 2007 analysis. Since 2007 we have updated this analysis to address several of the issues noted above, in order to evaluate the impact of these issues. EPA requests comment on the two approaches we examined for setting standards, and seeks input on alternative approaches, including the approach described in section VI.B.1.a.

In Table VI-1 we present weighted combined car and truck standards we developed based on efforts to update the work we did in 2007 to address some of the issues identified above. We show the results from our 2007 analysis, as well as the updated results when we utilize the same methodology for the 4% per year approach, but attempt to address a number of the issues discussed above. As part of addressing these issues, we have extended the time frame for our analysis to 2020, while our Light-duty Vehicle TSD analysis was limited to 2018. Our updated analysis results are documented in a separate technical memorandum available in the public docket for this Advance Notice. [130]

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[130] See EPA Technical Memorandum, "Documentation of Updated Light-duty Vehicle GHG Scenarios."

Table VI-1
Projected Vehicle CO_2 (gram/mile units) and MPG Standards (mpg units in square brackets), including A/C CO_2 limits

Year	Light-duty Vehicle TSD Analysis		Updated 2008 Analysis
	4 % Per Year	Model-Optimized	4 % Per Year
2011	338 [26.3]	334 [26.6]	335 [26.5]
2012	323 [27.5]	317 [28.0]	321 [27.7]
2013	309 [28.8]	295 [30.1]	307 [28.9]
2014	296 [30.0]	287 [31.0]	293 [30.3]
2015	285 [31.2]	281 [31.6]	283 [31.4]
2016	274 [32.4]	275 [32.3]	272 [32.7]
2017	263 [33.8]	270 [32.9]	261 [34.0]
2018	253 [35.1]	266 [33.4]	251 [35.4]
2019	n/a	n/a	241 [36.9]
2020	n/a	n/a	232 [38.3]

Compared to the Light-duty Vehicle TSD analysis, we have attempted in the updated analysis to address for potential CAA purposes several, but not all, of the noted issues, and as such we continue to believe that the results of this analysis are conservative -- that is, they tend to overestimate the costs and/or underestimate the benefits. We have included the following updates:

- Inclusion of plug-in hybrids as a viable technology beginning in 2012;
- Consideration of multi-year planning cycles available to manufacturers;
- Consideration of CO_2 trading between car and truck fleets within the same manufacturer;
- Assumption that all major manufacturers would comply with the standards rather than paying a monetary penalty;
- Correction of the CO_2 reduction effectiveness for diesel technology.

Our updated analysis does not address all of the issues we discussed previously. For example, we have not considered the widespread use of light-weight materials, further improvements in the CO_2 reduction effectiveness of existing technologies, potential for cost reductions beyond our 2007 analysis, and the potential for new technologies. We also have not addressed the potential changes in vehicle market shifts that may occur in the future in response to new standards, new consumer preferences, or the potential for higher fuel prices. Recent trends in the US auto industry indicate there may be a major shift occurring in consumer demand away from light-duty trucks and SUVs and towards smaller passenger cars.[131] Such potential trends are not captured in our analysis and they could have a first-order impact on the results.

Table VI-2 summarizes the most important societal and consumer impacts of the standards we have analyzed.

Table VI-2

Summary of Societal and Consumer Impacts from Potential Light-Duty Vehicle GHG Standards
(2006 $s, AEO2007 oil prices)

		Light-duty Vehicle TSD Analysis*		**Updated 2008 Analysis**
		4% per year	Model-Optimized	4% per year
Societal Impacts				
GHG Reductions (MMTCO2 equivalent in 2040)		378	343	635
Fuel Savings (million bpd in 2040)		2.3	2.0	4.2
Net Societal Benefits in 2040 (Billion $’s)**		$54 + B	$54 + B	$130 + B
Net Present Value of Net Benefits through 2040 (Billion $’s)**	3% DR	$320 + B	$390 + B	$830 + B
	7% DR	$120 + B	$160 + B	$340 + B
Consumer Impacts				
Per-Vehicle Costs	2015	$736	$672	$565
	2018	$1,567	$995	$1,380
	2020	n/a	n/a	$1,924
Payback Period***	3% DR	6.2 yr (2018)	4.8 yr (2018)	6.0 yrs. (2020)
	7% DR	8.9 yr (2018)	6.0 yr (2018)	8.7 yrs. (2020)
Lifetime Monetary Impact***	3% DR	$2,753 (2018)	$2,245 (2018)	$1,630 (2020)
	7% DR	$1,850 (2018)	$1,508 (2018)	$437 (2020)

[131] See “As Gas Costs Soar, Buyers Are Flocking to Small Cars”, New York Times, May 2, 2008, page A1.

* The Light-duty Vehicle TSD Societal Impacts are based on new stds. for 2011-2018 for cars and 2012-2017 for trucks, while the updated analysis is based on new stds. for 2011-2020 for cars and trucks.

** The identified "B" = unquantified benefits, for example, we have not quantified the co-pollutant impacts (PM, ozone, and air toxics), and does not include a monetized value for the social cost of carbon. Societal benefits exclude all fuel taxes because they represent transfer payments. In addition, for the updated analysis, we have not included the increased costs nor the GHG emissions of electricity associated with the use of plug-in electric hybrid vehicles. We have also not quantified the costs and/or benefits associated with changes in consumer preferences for new vehicles.

*** The payback period and lifetime monetary impact values for Light-duty Vehicle TSD analysis is for the average 2018 vehicle, and 2020 for the updated analysis.

Given the current uncertainty regarding the social cost of carbon, Table VI-2 does not include a monetized value for the reduction in GHG emissions. We present here a number of different values and indicate what impact they would have on the net social benefits for our updated analysis. Presentation of these values does not represent, and should not be interpreted to represent, any determination by EPA as to what the social cost of carbon should be for purposes of calculating benefits pursuant to the Clean Air Act.

We have analyzed the valuation for the social cost of carbon of $40 per metric ton (for emission changes in year 2007, in 2006 dollars, grown at a rate of 3% per year) that reflects potential global, including domestic, benefits of climate change mitigation. This valuation (which is the mean value from a meta analysis of global marginal benefits estimates for a 3% discount rate discussed in section III.G. of this Advance Notice) would result in an increase in the 2040 monetized benefits for the 2008 updated analysis of $67 billion. Given the nature of the investment in GHG reductions, we believe that values associated with lower discount rates should also be considered. For example, for a 2% discount rate for year 2007, the mean value from the meta analysis is $68 per metric ton. This valuation would result in an increase in the 2040 monetized benefits for the 2008 updated analysis of $110 billion.

As discussed in section III.G, another approach to developing a value for the social cost of carbon is to consider only the domestic benefits of climate change mitigation. The two approaches – use of domestic or global estimates -- are discussed in section III.G of this notice. There is considerable uncertainty regarding the valuation of the social cost of carbon, and in future analyses EPA would likely utilize a range of values (see section III.G).[132] Furthermore, current estimates are incomplete and omit a number of impact categories such that the IPCC has concluded that current estimates of the social cost of carbon are very likely to underestimate the benefits of GHG reductions.

This Advance Notice asks for comment on the appropriate value or range of values to use to quantify the benefits of GHG emission reductions, including the use of a global value. While OMB Guidance allows for consideration of international effects, it also suggests that the Agency consider domestic benefits in regulatory analysis. Section III.G.4 discusses very preliminary ranges for U.S. domestic estimates with means of $1 and $4 per metric ton in 2007, depending on the discount rate. These valuations ($1 and $4 per metric ton in 2007) would result in an increase in the 2040 monetized benefits for

[132] Ranges better reflect the available scientific information and the uncertainties in marginal benefits estimates, and the fact that there are estimates well above the means. The corresponding ranges for the 2007 mean estimates discussed above are the following: For the meta-analysis global marginal benefits estimates, the range is $-4 to $106 per metric ton CO2 based on a 3 percent discount rate, or $-3 to $159 per metric ton CO2 based on a 2 percent discount rate. The preliminary domestic ranges derived from a single model are $0 to $5 per metric ton CO2 based on a 3 percent discount rate, and $0 to $16 per metric ton CO2 based on a 2 percent discount rate.

the 2008 updated analysis of $1.7-6.7 billion. In its recent proposed rulemaking, NHTSA utilized $7 per metric ton as the initial value for U.S. CO_2 emissions in 2011.

Table VI-2 shows the impact of addressing a number of the issues noted above. With respect to per-vehicle costs, the updated 4% per year approach shows a $171 per vehicle lower cost in 2015 and a $187 per vehicle lower cost in 2018 compared to our 2007 analysis, for a slightly more stringent standard in both cases. This is primarily due to the impact of including multi-year planning and car-truck trading within a given manufacturer.

The estimated CO_2 reductions in 2040 from the updated analysis are much larger than the 2007 analysis (by nearly a factor of 2). This occurs primarily because we have addressed the diesel CO_2 issue noted above, and because we have extended the time frame for the analyzed standards to 2020. The estimated fuel savings are also larger primarily due to the additional years we extended the 4 % per year standard to. The estimated monetized net benefits for the updated analysis are also significantly higher than our previous estimates. This is a result of a combination of factors: lower estimates for the increased vehicle costs due to multi-year planning and within manufacturer car-truck trading; and the extension of the analyzed standards to 2020.

Table VI-2 also provides estimates of “payback period” and “lifetime monetary impact”. The payback period is an estimate of how long it will take for the purchaser of the average new vehicle to break-even; that is, where the increased vehicle costs is off-set by the fuel savings. Our updated analysis shows for the average 2020 vehicle that period of time ranges from 6.0 to 8.7 years (depending upon the assumed discount rate). The lifetime monetary impact provides an estimate of the costs to the consumer who owns a vehicle for the vehicle's entire life. The lifetime monetary impact is simply the difference between the higher initial vehicle cost increase and the lifetime, discounted fuel savings. Our updated analysis indicates the lifetime, discounted fuel savings will exceed the initial cost increase substantially. As shown in the table, the positive lifetime monetary impact ranges from about $440 to $1,630 per vehicle (depending upon the assumed discount rate). Section VI.C.2 of the Light-duty Vehicle TSD discusses possible explanations for why consumers do not necessarily factor in these fuel savings in making car-buying decisions.

Our updated analysis projects the 2020 CO2 limit of 232 gram/mile (38.3 mpg) shown in Table VI-1, could be achieved with about 33% of the new vehicle fleet in 2020 using diesel engines and full hybrid systems (including plug-in electric hybrid vehicles). Higher penetrations of these and other advanced technologies (including for example the wide-spread application of light-weight materials) could result in a much greater GHG reductions.

The results of our updated analysis indicate that:

- Technology is readily available to achieve significant reductions in light-duty vehicle GHG emissions between now and 2020 (and beyond);
- The benefits of these new standards far outweigh their costs;
- Owners of vehicles complying with the new standard will recoup their increased vehicle costs within 6-9 years, and;
- New standards would result in substantial reductions in GHGs.

We request comment on all aspects of this analysis, the appropriateness of the two approaches described, and the inputs and the tools that we utilized in performing the assessment, when considering the setting of light-duty vehicle GHG standards under the CAA. We also request comment on the alternative approach for establishing light-duty vehicle GHG standards described in section VI.B.1.a of this advance notice.

c. Technologies Available to Reduce Light-Duty Vehicle GHGs

In this section we discuss a range of technologies that can be used to significantly reduce GHG emissions from cars and light trucks. We discuss EPA's assessment of the availability of these technologies, their readiness for introduction into the market, estimates of their cost, and estimates of their GHG emission reduction potential. We request comment on all aspects of our current assessment, including supporting data regarding technology costs and effectiveness.

In the past year EPA undertook a comprehensive review of information in the literature regarding GHG-reducing technologies available for cars and light trucks. In addition, we reviewed confidential business information from the majority of the major automotive companies, and we met with a large number of the automotive companies as well as global automotive technology suppliers regarding the costs and effectiveness of current and future GHG-reducing technologies. EPA also worked with an internationally recognized automotive technology firm to perform a detailed assessment of the GHG reduction effectiveness of a number of advanced automotive technologies.[133]

EPA recently published a Staff Technical Report describing the results of our assessment, and we provided this report to the National Academy of Sciences Committee

[133] See "A Study of Potential Effectiveness of Carbon Dioxide Reducing Vehicle Technologies", Ricardo, Inc., EPA Report 420-R-08-004a, June 2008.

on the Assessment of Technologies for Improving Light-Duty Vehicle Fuel Economy.[134] This Staff Technical Report details our estimates of the costs and GHG reduction potential of more than 40 technologies applicable to light-duty vehicles, and is one of the key inputs to our analysis of potential future standards presented in Section VI.B.1.b. These technologies span a large range of effectiveness and technical availability, from technologies as simple as reduced rolling resistance tires (offering a 1-2% reduction in vehicle CO_2 emissions) to advanced powertrain systems like gasoline and diesel hybrids, plug-in electric hybrids, and full electric vehicles (offering up to a 100% reduction in vehicle CO_2 emissions).

The majority of the technologies we investigated are in production and available on vehicles today, either in the United States, Japan or Europe. Over the past year, most of the major automotive companies or suppliers have announced the introduction of new technologies to the US market. The following are some recent examples:

- Ford's new "EcoBoost" turbocharged, down-sized direct-injection gasoline engines;
- Honda's new 2009 global gasoline hybrid and 2009 advanced diesel powertrain;
- Toyota and General Motors plans for gasoline plug-in hybrid systems within the next two to three years;
- General Motors breakthroughs in lower-cost advanced diesel engines;
- Nissan's 2010 introduction of a clean diesel passenger car;

[134] See "EPA Staff Technical Report: Cost and Effectiveness Estimates of Technologies Used to Reduce Light-duty Vehicle Carbon Dioxide Emissions", EPA Report 420-R-08-008, March 2008.

- Chrysler's widespread use of dual-clutch automated manual transmissions beginning in 2009; and,
- Mercedes' new product offerings for clean diesel applications as well as diesel-electric hybrid technologies.

We also evaluated the costs and potential GHG emissions reductions from some of the advanced systems not currently in production or that are only available in specialty niche vehicles, such as gasoline homogeneous charge compression ignition engines, camless valve actuation systems, hydraulic hybrid powertrains, and full electric vehicles. These technologies are described in detail, along with our estimates for costs and GHG reduction potential, in our Staff Technical Report.

An additional area where we see opportunities for significant CO_2 emissions reduction is in material weight substitution. The substitution of traditional vehicle materials (e.g., steel, glass) with lighter materials (e.g., aluminum, plastic composites) can provide substantial reductions in CO_2 emissions while maintaining or enhancing vehicle size, comfort, and safety attributes. Several companies have recently announced plans to utilize weight reduction as a means to improve vehicle efficiency while meeting all applicable safety standards.[135] We request data and comment on the extent to which material substitution should be considered as a means to reduce GHG emissions, and information on the costs and potential scope of material substitution over the next 5 to 20 years.

Finally, we note that in the past 30 years there has been a steady, nearly linear increase in the performance of cars and light trucks. We estimate that the average new

[135] See Automotive News, February 11, 2008, in which Daimler-Benz CEO states that Mercedes-Benz will reduce the weight of all new vehicle models by 5%, and Ford announces every model will lose between 250 and 750 pounds.

vehicle sold in 2007 had a 0-60 miles/hour acceleration time of 9.6 seconds – compared to 14.1 seconds in 1975.[136] If this historic trend continues, by 2020 the average 0-60 acceleration for the combined new car and truck fleet will be less than 8 seconds. During the past 20 years, this increase in acceleration has been accompanied by a gradual increase in vehicle weight. It is generally accepted that over the past 20 years, while fuel economy for the light-duty fleet has changed very little, the fuel efficiency has in fact improved but has largely been used to enable increases in both the weight and the performance of vehicles. We request comment on how we should consider the potential for future changes in vehicle weight and performance (e.g., acceleration time) in assessing the costs and benefits of standards for reducing GHG emissions.

d. Potential Options for Reducing HFCs, N_2O, CH_4, and Air Conditioning-Related CO_2

As described above, in addition to fleet average and in-use CO_2 standards, EPA has analyzed how new control measures might be developed for other car and light truck emissions that have global warming impacts: air conditioning ("A/C")-related emissions of HFCs and CO_2, and tailpipe emissions of nitrous oxide (N_2O), and methane (CH_4). Under CAA section 202(a), EPA may regulate these emissions if a positive endangerment finding is made for the relevant GHGs. Together, these emissions account for about 10% of greenhouse gases from light-duty cars and trucks (on a CO_2 equivalent basis). The direct HFC emissions account for 4.3%, while the A/C CO_2 emissions are 3.1%. N_2O and CH_4 account for 2.7% and 0.2% respectively. With regard to air conditioning-related emissions, significant opportunity exists to reduce HFC emissions

[136] See "Light-Duty Automotive Technology and Fuel Economy Trends: 1995-2007", EPA Report EPA420-R-07-008, September 2007.

from refrigerant leakage and CO_2 from A/C induced engine loads, and EPA has considered potential standards to reduce these emissions. In addition, EPA has considered potential limits for N_2O and CH_4 emissions that could apply to both cars and light trucks that would limit future growth of these emissions.

i. Potential controls for air conditioning-related GHG emissions

Over 95% of the new cars and light trucks in the U.S. are equipped with A/C systems. There are two mechanisms by which A/C systems contribute to the emissions of GHGs. The first is through direct leakage of the refrigerant (currently the HFC compound R134a) into the air. Based on the higher GWP of HFCs, a small leakage of the refrigerant has a greater global warming impact than a similar amount of emissions of other mobile source GHGs. Leakage can occur slowly through seals, gaskets, hose permeation and even small failures in the containment of the refrigerant, or more quickly through rapid component deterioration, vehicle accidents or during maintenance and end-of-life vehicle scrappage (especially when refrigerant capture and recycling programs are less efficient). The leakage emissions can be reduced through the choice of leak-tight, durable components, or the global warming impact of leakage emissions can be addressed through the implementation of an alternative refrigerant. Refrigerant emissions during maintenance and at the end of the vehicle's life (as well as emissions during the initial charging of the system with refrigerant) are already addressed by the CAA Title VI stratospheric ozone protection program, as described in section VIII of this notice.[137]

[137] The second mechanism by which vehicle A/C systems contribute to GHG emissions is through the consumption of excess fuel when the A/C system is running, and from carrying around the weight of the A/C system hardware all-year round. This excess fuel required to run the system is converted into CO_2 by

EPA's analysis indicates that together, these A/C- related emissions account for about 7.5% of the GHG emissions from cars and light trucks. EPA considered standards designed to reduce direct leakage emissions by 75% and to reduce the incremental increase of A/C related CO_2 emissions by 40% in model year 2015 vehicles, phasing in starting in model year 2012. It is appropriate to separate the discussion of these two categories of A/C-related emissions because of the fundamental differences in the emission mechanisms and the methods of emission control. Refrigerant leakage control is akin in many respects to past EPA fuel evaporation control programs in that containment of a fluid is the key control feature, while efficiency improvements are more similar to the vehicle-based control of CO_2 in that they would be achieved through specific hardware and controls.

The Memo to the Docket, "Light-Duty Vehicle Hydrofluorocarbon, Nitrous Oxide, Methane, and Air Conditioning-Related Carbon Dioxide Emissions" provides a more detailed discussion of the air conditioning-related GHG emissions, both refrigerant leakage and CO_2 emissions from A/C use, as well as potential test procedure and compliance approaches that have been considered by EPA.

ii. Feasibility of potential A/C reduction approaches

EPA believes that significant reductions in A/C HFC leakage and A/C CO_2 emissions would be readily technically feasible and highly cost effective. The types of technologies and methods that manufacturers could use to reduce both types of A/C

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the engine during combustion. This excess CO_2 from A/C operation can thus be reduced by increasing the efficiency of the overall vehicle-A/C system.

emissions are commercially available and used today in many models of U.S. cars and light trucks. For example, materials and components that reduce leakage as well as electronic monitoring systems have been used on various vehicles in recent years. Regarding A/C CO_2 reduction, such technologies as variable-displacement compressors and their controls are also in use today. Although manufacturers might find that more advanced technologies, like alternate refrigerants, become economically attractive in the coming years, EPA believes that currently available technologies and systems designs would be sufficient to meet potential limits being assessed by EPA.

iii. Potential impacts of requiring improved A/C systems

(1) Emission reductions for improved A/C systems

Manufacturers producing cars and light trucks for the U.S. market have not historically had economic or regulatory incentives or requirements to reduce refrigerant leakage and CO_2 from A/C systems. As a result, there is an opportunity for significant reductions in both of these types of emissions. With potential standards like the ones considered above, EPA has estimated that reductions in HFC refrigerant leakage, converted to CO_2 equivalent emissions, and added to projected A/C CO_2 reductions, these limits would result in an average per-vehicle reduction in CO_2-equivalent emissions of about 4.7% (excluding CH_4 and N_2O from the baseline). This reduction is equivalent to about 7.5% of light vehicle CO_2-equivalent emissions, or about 2 tons per year.

(2) Potential costs for improved A/C systems

Although the technologies and system designs EPA expects could be used to comply with the two A/C related standards being considered are currently available, not all manufacturers are using them on all vehicles. Thus, the industry would necessarily incur some costs to apply these technologies more broadly across the car and truck fleet. EPA estimates that the cost of meeting the full HFC leakage standard it is considering would average about $40 per vehicle (retail price equivalent or RPE) and that the cost of meeting the A/C CO_2 standard would be about $70 per vehicle (RPE). At the same time, complying with such limits would result in very significant savings in fuel costs (as system efficiency improves) and in A/C-related maintenance costs (as more durable systems result in less frequent repairs). In fact, EPA's analysis shows that these cost savings would significantly exceed projected retail costs of the potential A/C standards, more than offsetting the costs of both types of A/C system improvements.[138]

iv. Potential interaction with Title VI refrigerant regulations

As described further in Section VIII of this notice, Title VI of the CAA deals with the protection of stratospheric ozone. Section 608 of the Act establishes a comprehensive program to limit emissions of certain ozone-depleting substances (ODS) from appliances and refrigeration. The rules promulgated under section 608 regulate the use and disposal of such substances during the service, repair or disposal of appliances and industrial

[138] See Appendix 3.B. of the EPA Technical Memorandum "Documentation of Updated Light-duty Vehicle GHG Scenarios" for a detailed discussion of these costs estimates.

process refrigeration. In addition, section 608 and the regulations promulgated under it prohibit the knowingly venting or releasing ODS during the course of maintaining, servicing, repairing or disposing of an appliance or industrial process refrigeration equipment. Section 609 governs the servicing of motor vehicle air conditioners (MVACs). The regulations promulgated under section 609 (40 CFR part 82, subpart B) establish standards and requirements regarding the servicing of MVACs. These regulations include establishing standards for equipment that recovers and recycles or only recovers refrigerant (CFC-12, HFC 134a, and for blends only recovers) from MVACs; requiring technician training and certification by an EPA-approved organization; establishing recordkeeping requirements; imposing sales restrictions; and prohibiting the venting of refrigerants.

Another Title VI provision that could interact with potential Title II motor vehicle regulation of GHGs is section 612, which requires EPA to review substitutes for ozone depleting substances and to consider whether such substitutes would cause an adverse effect to human health or the environment as compared with other substitutes that are currently or potentially available. EPA promulgated regulations for this program in 1992 and those regulations are located at 40 CFR part 82, subpart G. When reviewing substitutes, in addition to finding them acceptable or unacceptable, EPA may also find them acceptable so long as the user meets certain use conditions. For example, all motor vehicle air conditioning system must have unique fittings and a uniquely colored label for the refrigerant being used in the system.

EPA views the potential program analyzed here as complementing these Title VI programs, and not conflicting with them. The potential standards would apply at preproduction when manufacturers demonstrate that they are utilizing requisite equipment (or utilizing other means designated in the potential program) to achieve the suggested 75% leak reduction requirement. These requirements would dovetail with the Title VI section 609 standards which apply to maintenance events, and to end-of-vehicle life disposal. In fact, as noted, a benefit of a program is that there could be fewer and less impactive maintenance events for MVACs, since there would be less leakage. In addition, although the suggested standards would also apply in-use, the means of enforcement should not conflict (or overlap) with the Title VI section 609 standards. EPA also believes the menu of leak control technologies described above would complement the section 612 requirements because these control technologies would help ensure that 134a (or other refrigerants) would be used in a manner that would further minimize potential adverse effects on human health and the environment.

v. Potential controls for nitrous oxide emissions

Nitrous oxide, or N_2O, is emitted from gasoline and diesel car and light truck tailpipes and is generated during specific catalyst warm-up temperature conditions conducive to N_2O formation. While N2O emissions from current Tier 2 vehicles with conventional three-way catalysts are relatively low on a mass basis (e.g., around 0.005 g/mi), N2O does have a high GWP of 310. N_2O is a more significant concern with diesel vehicles (and potentially future gasoline lean-burn engines) equipped with advanced catalytic NO_X emissions control systems. These systems can (but need not) be designed in a way that emphasizes efficient NO_X control while allowing the formation of significant quantities of N_2O. Excess oxygen present in the exhaust during lean-burn conditions in diesel (or lean-burn gasoline) engines equipped with these advanced systems can favor N_2O formation if catalyst temperatures are not carefully controlled. Without specific attention to controlling N_2O emissions in the development of such new NO_X control systems, vehicles could have N_2O emissions many times greater than are emitted by current gasoline vehicles.

EPA has considered a “cap” approach to controlling N2O emissions would not require any new technology for current Tier 2 gasoline vehicles, but would limit any increases in N2O emissions that might otherwise occur with future technology vehicles. Such an approach would have minimal feasibility, emissions, or cost impacts.

The Memo to the Docket, “Light-Duty Vehicle Hydrofluorocarbon, Nitrous Oxide, Methane, and Air Conditioning-Related Carbon Dioxide Emissions” has more in-depth discussion of car and light truck N2O emissions, as well as of potential test procedure and compliance approaches that have been considered by EPA.

vi. Potential controls for methane emissions

Methane, or CH4, is emitted from gasoline and diesel car and light truck tailpipes and is one of the family of hydrocarbon compounds generated in the engine as a by-product of gasoline and diesel fuel combustion. As such, levels of CH4 emissions have been somewhat controlled by the lower hydrocarbon emissions standards that have been phased in since the early 1970s. Current CH4 emissions from Tier 2 gasoline vehicles are relatively low (about 0.017 g/mi on average), and CH4 has a global warming potential of 23. The one technology where much higher CH_4 emissions could be of concern would be natural gas-fueled vehicles, since CH_4 is the primary constituent of natural gas fuel and would be the largest component of unburned fuel emissions.

As with N_2O, EPA has considered a "cap" CH_4 emissions standard approach that would not require any new technology for current Tier 2 gasoline vehicles, but would limit any increases in CH_4 emissions that might otherwise occur with future natural gas vehicles. Such an approach would have no significant feasibility, emissions, or cost impacts.

The Memo to the Docket, "Light-Duty Vehicle Hydrofluorocarbon, Nitrous Oxide, Methane, and Air Conditioning-Related Carbon Dioxide Emissions" has greater discussion of car and light truck CH_4 emissions.

e. Specific Programmatic Design Issues

As discussed above, Title II of the CAA provides the Agency with both direction and flexibility in designing and implementing a GHG control program. Consistent with existing motor vehicle programs, the Agency would need to develop appropriate mechanisms to address issues such as certification of new motor vehicles to applicable standards, ensuring the emissions requirements are being met throughout the designated useful life of the vehicle, and appropriate compliance mechanisms if the requirements are not being met. Domestic and imported vehicles and engines subject to emissions standards must obtain a certificate of conformity in order to be sold in the US marketplace. EPA has utilized a wide range of program design tools and compliance mechanisms to help address the large variation of market participants yet still provide a level regulatory playing field for these parties. As part of the design effort for a GHG program, it would be appropriate to take into account these flexibilities as well as existing requirements that the automobile and engine industries already face in order to help reduce compliance costs if possible while still maintaining our overall environmental objectives. However, given the nature of GHG control, it would also be appropriate to determine if new design structures and compliance measures might be more effective.

The Light-duty Vehicle TSD includes a discussion of a wide range of programmatic and technical issues and presents potential approaches that would address these issues in the design of a comprehensive near-term light-duty vehicle GHG control program. We highlight here a few of these issues, and point the reader to the Light-duty Vehicle TSD for additional detail. Among the issues discussed in the Light-duty Vehicle TSD are several which could differ significantly under a different approach. EPA specifically requests comment on these issues:

- Potential classification approaches for light-duty vehicles (e.g., treating cars and light trucks in a single averaging class or separate, and the potential classification of vehicle types as either a passenger car or a light truck);
- How any classification approaches would relate to NHTSA's regulatory approach;

- The significant flexibilities allowed under Title II which we utilize for existing criteria pollutant standards for light-duty vehicles, including detailed concepts for a GHG averaging, banking, and trading program;
- Potential light-duty GHG compliance program concepts.

As we have considered various potential light-duty vehicle GHG approaches, significant thought and stakeholder outreach went into designing a potential system for determining compliance that would meet Agency and industry needs and goals. The Light-duty Vehicle TSD presents a compliance structure for vehicle GHG control that adheres to CAA requirements and at the same time is compatible with the existing CAFE program. However, this is not the only approach to compliance, as is discussed in the Light-duty Vehicle TSD. Other compliance approaches could also be considered, each with their own advantages. For example, a GHG compliance program patterned after the Tier 2 light duty vehicles emissions program offers an approach that is more similar to the existing compliance structure for other pollutants.

We discuss below in detail three specific issues regarding potential future light-duty vehicle GHG programmatic issues: universal and attribute-based standards; environmental backstop standards; and tailpipe CO_2 test cycles.

i. Universal and attribute-based vehicle GHG standard approaches

A specific programmatic issue that EPA would like to highlight here is the use of attribute-based standards for vehicle GHG standards, and the concept of an environmental backstop to accompany an attribute-based standard promulgated under the

CAA, in order to assure that GHG emission reductions which are feasible at reasonable cost under section 202 (a) are not foregone. A CAA program for reducing GHG emissions from light vehicles could set the average emissions standards for manufacturers in one of two fundamental ways. A "universal" GHG standard would apply a single numerical requirement to each manufacturer, to be met on average across its entire light-duty vehicle production. One potential consequence of the universal approach is that the costs of compliance may fall unevenly on different manufacturers. That is, complying with a single standard would be more difficult for companies with current product mixes weighted relatively heavily toward vehicles with higher compliance costs.

The other approach EPA has considered would set individual standards for each manufacturer, based on one or more vehicle attributes (such as the footprint attribute approach currently used by NHTSA). Thus, to the extent a manufacturer produced vehicles with different attributes from the vehicles of another manufacturer; unique standards would be set for each company. The Light-duty Vehicle TSD discusses various vehicle attributes on which light duty vehicle CO_2 standards could be based. EPA requests comment on the use of an attribute-based approach, and on each of the attributes considered in the Light-duty Vehicle TSD, as well as on a universal standard approach. In addition, some in the industry have suggested power-to-weight ratio may be an appropriate attribute for this purpose, and we request comment on that attribute as well.

A key characteristic of any attribute-based program is that significant industry shifts in the attribute over time would increase or decrease the average emission performance requirement for the fleet. For example, if such a shift in attributes resulted in the unique manufacturer standards being on average less stringent than those determined to be feasible and cost-effective in the establishment of the program, the program would fall short of those overall emissions reductions, and conversely, market shifts could also result in larger emissions reductions than those determined to be feasible and cost-effective at the time the program was established. EPA seeks comment on the universal approach as compared to the attribute-based approach.

ii. Concepts for light-duty vehicle GHG environmental backstops

In order to limit the potential loss of feasible emissions control due to a change in market attributes, EPA could consider a supplemental “backstop” carbon dioxide emissions standard for each year (also referred to as an “anti-backsliding” provision) as a complement under the CAA to an attribute-based standard. This would be an additional obligation for manufacturers that would limit the maximum fleet average carbon dioxide emissions, independent of attributes. The backstop requirement could establish fixed minimum and feasible fleet average CO_2 g/mile standards. The backstop would apply separately to the domestic car, import car, and truck classes. This backstop obligation may not apply to small volume manufacturers. While EPA will quantitatively describe one specific backstop concept below, we are seeking public comment on a range of alternative approaches described qualitatively below, briefly, as well. More generally, EPA seeks comment as to whether a backstop approach would be appropriate under the CAA as a means of providing greater emission reduction certainty.

A backstop could be an appropriate complement under the CAA to an attribute-based standard. The most important factor under section 202 (a) of the Act is to ensure reductions of the emissions from the motor vehicle sector which cause or contribute to the endangerment caused by greenhouse gas emissions. As discussed earlier, one important feature of an attribute-based program is that collective decisions by consumers and manufacturers could result in higher or lower industry-wide average footprint values than projected by EPA at the time of promulgation. Since the attribute-based curve establishes a fleet average for a manufacturer based on the manufacturer's sales and attribute values, the actual reductions achieved by the program could vary as this mix varies. In the extreme, if the entire industry moved to much higher attribute values, then the carbon dioxide emissions reductions could be significantly less than projected by EPA as technically feasible and cost effective.

Under section 202 (a), EPA could consider a supplemental fleet average backstop standard that would be the same for every manufacturer in a given year. Such a standard would ensure that a minimum level of reductions would be achieved as the fleet mix changes over time. EPA could base such a standard on feasible carbon dioxide emission reductions and other important factors such as technological feasibility, cost, energy, and safety in analyzing section 202 (a) standards. EPA recognizes that a CO_2 emissions backstop could partially reduce the flexibility and market elements of an attribute-based approach, but believes it could be needed to provide for an appropriate degree of emissions reduction certainty.

As with other structural issues such as universal versus attribute-based approaches, EPA believes that various backstop approaches have conceptual advantages and disadvantages with respect to relevant criteria such as certainty of industry-wide carbon dioxide emissions reductions, flexibility with respect to consumer choice and vehicle offerings, varying treatment of automakers, and complexity of explanation and implementation. Any approach would also need to address the relevant factors, including cost (economic feasibility, cost effectiveness, and per vehicle cost) and technological feasibility. EPA encourages commenters to evaluate the design approaches presented below, as well as to suggest alternative approaches, in terms of these and other relevant criteria.

As an illustrative example, Table VI-3 shows one set of fleet average carbon dioxide emissions and mpg backstops, along with the projected, average industry-wide carbon dioxide emissions and mpg compliance levels, for the two sets of fleet average carbon dioxide emissions standards based on the footprint attribute, analyzed in December 2007, and discussed earlier in this advance notice: the 4% per year and model-optimized scenarios. These carbon dioxide emissions backstops are based on the projected fleet average carbon dioxide emissions compliance levels for the high-volume car and light truck manufacturers with the highest projected car and light truck footprint levels, based on the footprint curves that were developed by EPA in December 2007. Chrysler is the high-volume car manufacturer with the highest projected footprint values, and General Motors has the highest projected footprint values among the high-volume truck manufacturers.

These backstops would be universally applied to every manufacturer, except small volume manufacturers, and would become the effective fleet average standard for any automaker that would otherwise have a higher fleet average carbon dioxide emissions standard, for any of the three respective averaging sets (import and domestic cars and trucks), based on the footprint curve.

The underlying rationale for this backstop approach is that the manufacturer that is projected to sell the highest footprint vehicles, which therefore is projected to be able to comply with the highest fleet average carbon dioxide emissions compliance levels, should be treated as establishing the minimum acceptable level of emissions reductions for the industry. Similarly, no other manufacturers should exceed the feasible, cost effective level established by that projected highest footprint manufacturer. The approach, and underlying rationale, is similar to the approach used by NHTSA before the 2006 truck standards, whereby the level of a universal standard was established based on the capabilities of the least capable large manufacturer (Public Citizen v. NHTSA, 848 F. 2d 256, 259, D.C. Cir. 1988). Although the backstop would not prohibit the highest footprint manufacturer from selling higher footprint vehicles, it would prohibit any carbon dioxide emissions “backsliding” that would otherwise be associated with that increase in footprint. Average carbon dioxide emissions from other manufacturers could increase, of course, in accordance with the footprint curve, but in no case could the carbon dioxide emissions level for any manufacturer increase beyond these backstop levels.

The passenger car carbon dioxide emissions and mpg backstop levels shown in Table VI-3 adhere to the methodology described above with one exception. Based on Chrysler’s projected footprint values, its 2011 standard for the 4% per year option would be 325 g/mi, equivalent to a gasoline vehicle fuel economy of 27.3 mpg. Since the current car CAFE standard, which acts as an effective fuel economy backstop, is 27.5

mpg, EPA could instead consider a 2011 backstop of 323 g/mi for the 4% per year option, which is equivalent to a 27.5 mpg gasoline vehicle.

In this illustrative backstop example, the carbon dioxide emissions backstop levels would range from 8 to 22 g/mi, or 2 to 8%, higher than the projected, average industry-wide carbon dioxide levels.

Table VI-3. Illustrative Backstops for the Fleet Average Carbon Dioxide Emissions Standard (CO_2 grams per mile / mpg)

CARS				
	4 percent per year option		Model-optimized option	
	Projected industry-wide CO_2 levels	Backstop	Projected industry-wide CO_2 levels	Backstop
2010 (base)	(323) / 27.5	--	(323) / 27.5	--
2011	309 / 28.7	323 / 27.5	301 / 29.5	317 / 28.0
2012	298 / 29.8	319 / 27.8	291 / 30.5	314 / 28.3
2013	285 / 31.1	296 / 30.0	276 /32.1	287 / 30.9
2014	275 / 32.3	287 / 30.9	268 / 33.2	281 / 31.6
2015	264 / 33.6	277 / 32.0	260 / 34.1	273 / 32.5
2016	254 / 34.9	266 / 33.4	247 / 35.9	258 / 34.4
2017	244 / 36.3	257 / 34.5	244 / 36.4	257 / 34.5
2018	235 / 37.7	245 / 36.2	239 / 37.2	249 / 35.7

A second illustrative example of a universal backstop approach could be modeled on the “minimum standard” in the Energy Independence and Security Act (EISA) of 2007. EISA establishes a fuel economy backstop for the domestic car class that is equal to 92% of the average fuel economy level projected for all cars. EPA believes this 92% value was derived by dividing the current car CAFE standard of 27.5 mpg by the average industry-wide car fuel economy performance over the past several years. The car CAFE standard, in effect, has served as a backstop for those manufacturers that have chosen not to pay CAFE penalties. Applying this model to a carbon dioxide emissions backstop would involve dividing the average projected industry-wide carbon dioxide emissions levels by 0.92, or multiplying by a factor of 1.087, an increase of 8.7%, to generate a universal backstop level that would apply to all manufacturers. Under this approach, the backstop levels for the 4% per year and model-optimized standards in Table VI-3 would be greater than the backstop levels discussed earlier in every case, ranging from 3 to 23 g/mi higher. This alternative approach yields backstop levels 20 to 31 g/mi higher than the projected, average industry-wide standards,

For the backstop approaches discussed above, all automakers would have the same uniform backstop for domestic and import cars, and a higher uniform backstop for trucks. These universal approaches would make the backstop more of a constraint on those manufacturers that sold vehicles with higher average footprint levels and less of a constraint on those automakers that sold vehicles with lower average footprint levels.

An alternative backstop approach could be to establish unique maximum numerical carbon dioxide emissions values that would apply to different automakers (e.g., X g/mi for Automaker A, and Y g/mi for Automaker B) and that would become the effective fleet average standard for an individual automaker when that automaker would otherwise be allowed to meet a higher fleetwide average carbon dioxide emissions value based exclusively on the footprint curve. The rationale for this type of approach would be that since manufacturers start at different average footprint levels, manufacturer-specific backstop values could provide greater insurance against carbon dioxide emissions backsliding for all manufacturers, rather than just those manufacturers that sold vehicles with higher average footprint levels. One illustrative example of this type of approach would be to base the annual backstop for each manufacturer on its 2010 carbon dioxide emissions baseline, reducing it by the same percentage each year. A similar approach would base the annual backstop for the highest-footprint manufacturer on its 2010 carbon dioxide emissions baseline reduced by a percentage each year, the annual backstop for the lowest-footprint automaker on its 2010 carbon dioxide emissions baseline reduced by a lesser percentage per year, and the annual backstop values for other manufacturers on annual percentage reductions between the higher and lower percentages. This latter approach would yield backstop values that would be somewhat more binding on manufacturers that sold vehicles with higher average footprint values, yet still binding to some degree on all automakers. This approach would also limit the degree to which manufacturers that sold vehicles with lower average footprint values could increase average footprint values over time

A combination of the universal and manufacturer-specific approaches could be to begin with manufacturer-specific backstop values, and to transition to uniform backstop values over a 5 or 10 year period.

Another alternative backstop approach would not set a maximum numerical carbon dioxide emissions value for individual manufacturers, but would establish mathematical functions that would automatically increase the stringency of and/or "flatten" the footprint curves for future years when actual industry-wide carbon dioxide emissions performance in the future is found to fall short of EPA's projections at the time of promulgation. For example, at the time of promulgation, EPA could assume a certain average industry-wide carbon dioxide g/mi emissions level for 2011-2012. If, in 2013, EPA found that the average industry-wide emissions level in 2011-2012 was higher than projected in the final rule (and therefore the carbon dioxide emissions reductions were lower than projected because of higher than projected average footprint levels), then the backstop provisions would be triggered and the footprint curves for future years (say, 2016 and later) would be automatically changed to be more stringent and/or flatter in shape. This approach would reframe the backstop issue in terms of industry-wide emissions performance, rather than in terms of individual automaker emissions performance.

In lieu of a backstop, another approach would be to flatten (i.e., reduce the slope of) the carbon dioxide emissions-footprint curve such that there would a major disincentive for automakers to increase vehicle footprint. EPA invites comments on the pros and cons of this approach relative to a backstop.

In conclusion, EPA seeks comment on whether a CO_2 emissions backstop is an appropriate complement to a footprint-based regulatory approach under the CAA to ensure that the program would achieve a minimum level of feasible carbon dioxide emissions reductions. EPA invites comments on both the potential backstop approaches discussed above, as well as suggestions for other approaches.

iii. Potential test procedures for light-duty vehicle tailpipe CO_2 emissions

For the program options EPA analyzed to date, EPA would expect manufacturers and EPA to measure CO_2 for certification and compliance purposes over the same test procedures currently used for measuring fuel economy, except for A/C-related CO_2 emissions. This corresponds with the data used in our analysis of the potential footprint-based CO_2 standards presented in section VI.B.1.b of this advance notice, as the data on control technology efficiency was also developed in reference to these test procedures. These procedures are the Federal Test Procedure (FTP or ‘‘city’’ test) and the Highway Fuel Economy Test (HFET or ‘‘highway’’ test). EPA established the FTP for emissions measurement in the early 1970s. In 1976, in response to requirements in the Energy Policy and Conservation Act (EPCA), EPA extended the use of the FTP to fuel economy measurement and added the HFET. The provisions in the 1976 regulation, effective with the 1977 model year, established procedures to calculate fuel economy values both for labeling and for CAFE purposes. Under EPCA, EPA is required to use these procedures (or procedures which yield comparable results) for measuring fuel economy for cars for CAFE purposes, but not for fuel economy labeling purposes. EPCA does not impose this requirement on CAFE test procedures for light trucks, but EPA does use the FTP and HFET for this purpose.

On December 27, 2006, EPA established new “5-cycle” test procedures for fuel economy labeling -- the information provided to the car-buying public to assist in making fuel economy comparisons from vehicle to vehicle. These procedures were originally developed for purposes of criteria emissions testing, not fuel economy labeling, pursuant to section 206(h) of the Clean Air Act, which requires EPA to review and revise as necessary test procedures for motor vehicles and motor vehicle engines “to insure that vehicles are tested under circumstances which reflect the actual current driving conditions under which motor vehicles are used.” In updating the fuel economy labeling regulations, EPA determined that these emissions test procedures take into account several important factors that affect fuel economy in the real world but are missing from the FTP and HFET tests. Key among these factors are high speeds, aggressive accelerations and decelerations, the use of air conditioning, and operation in cold temperatures. Consistent with section 206 (h), EPA revised its procedures for calculating the label estimates so that the miles per gallon (mpg) estimates for passenger cars and light-duty trucks would better reflect what consumers achieve in the real world. Under the new methods, the city miles per gallon estimates for the manufacturers of most vehicles have dropped by about 12 % on average relative to the previous estimates, with estimates for some vehicles dropping by as much as 30%. The highway mpg estimates for most vehicles dropped on average by about 8%, with some estimates dropping by as much as 25% relative to the previous estimates. The new test procedures only affect EPA's vehicle fuel economy labeling program and do not affect fuel economy measurements for the CAFE standards, which continue to be based on the original 2-cycle test procedures (FTP/HFET).

EPA continues to believe that the new 5-cycle test procedures more accurately predict in-use fuel economy than the 2-cycle test procedures. Although, as explained below, to date there has been insufficient information to develop standards based on 5-cycle test procedures, such information could be developed and there is no legal constraint in the CAA to developing such standards. Indeed, section 206(h) provides support for such an approach. Now that automotive manufacturers are using the 5-cycle test procedure for labeling purposes, we anticipate significant amount of data regarding the impact of the 5-cycle test on vehicle CO_2 emissions will be made available to the Agency over the next several years.

However, for the programs analyzed in the Light-duty Vehicle TSD, EPA used the original 2-cycle test. Indeed, data were simply lacking for the efficiencies of most fuel economy control measures as measured by 5-cycle tests. Thus, existing feasibility studies and analyses, such as the 2002 National Academy of Sciences (NAS) and the 2004 Northeast States Center for a Clean Air Future (NESCCAF) studies that examined technologies to reduce CO_2, were based on the 2-cycle test procedures. However, as noted above, we expect that new data regarding the 5-cycle test procedures will be made available and could be considered in future analysis.

It is important to note, however, that all of our benefits inputs, modeling and environmental analyses underlying the potential programs analyzed in the Light-duty Vehicle TSD accounted for the difference between emissions levels as measured by the 2-cycle test and the levels more likely to actually be achieved in real world performance. Thus, EPA applied a 20% conversion factor (2-cycle emissions result divided by 0.8) to convert industry-wide 2-cycle CO_2 emissions test values to real world CO_2 emissions factors. EPA used this industry-wide conversion factor for all of its emission reduction estimates, and calculated such important values as overall emission reductions, overall benefits, and overall cost-effectiveness using these corrected values. In reality, this conversion factor is not uniform across all vehicles. For example, the conversion factor is greater than 20% for vehicles with higher fuel economy/lower CO_2 values and is less than 20% for vehicles with lower fuel economy/higher CO_2 values. But to simplify the technology feasibility analysis, the analysis assumed a uniform conversion factor of 20% for all vehicles. EPA does not believe the overall difference would have a significant effect on the standards because the errors on either side of 20% tend to offset one another.

EPA thus analyzed CO_2 standards based on the 2-cycle test procedures for our analysis to date. EPA would expect to continue to gain additional experience and data on the 5-cycle test procedures used in the labeling program. If EPA determined that analyzing potential CO_2 standards based on these test procedures would result in more robust control of those emissions, we would consider this in future analyses. EPA requests comments on the above test procedure issues, and the relative importance of using the 2-cycle versus the 5-cycle test in any future EPA action to establish standards for light-duty vehicle tailpipe CO_2 emissions.

2. Heavy-Duty Trucks

Like light-duty vehicles, EPA's regulatory authority to address pollution from heavy-duty trucks comes from section 202 of the CAA. The Agency first exercised this responsibility for heavy-duty trucks in 1974. Since that time, heavy-duty truck and diesel engine technologies have continued to improve, and the Agency has set increasingly stringent emissions standards (today's diesel engines are 98% cleaner than those from 1974). Over that same period, freight shipment by heavy-duty trucks has more than doubled. Goods shipped solely by truck account for 74% of the value of all commodities shipped within the United States. Trucked freight is projected to double again over the next two decades, growing from 11.5 billion tons in 2002 to over 22.8 billion tons in 2035.[139] Total truck GHG emissions are expected to grow with this increase in freight.

Reflecting important distinctions between light and heavy-duty vehicles, section 202 gives EPA additional guidelines for heavy-duty vehicle regulations for certain pollutants, including defined regulatory lead time criteria and authority to address heavy-duty engine rebuild practices. The Agency has further used the discretion provided in the CAA to develop regulatory programs for heavy-duty vehicles that reflect their primary function. Key differences between our light-duty and heavy-duty programs include vehicle standards for cars versus engine standards for heavy-duty trucks, gram per distance (mile) standards for cars versus gram per work (brake horsepower-hour) for trucks, and vehicle test procedures for cars versus engine-based tests for trucks. EPA has thus determined that in the heavy-duty sector, the appropriate metric to evaluate performance is per unit of work and that engine design plays a critical role in controlling criteria pollutant emissions. EPA's rules also reflect the nature of the heavy-duty industry with separate engine and truck manufacturers. As EPA considers the best way to address GHG emissions from the heavy-duty sector, we will again be considering the important ways that heavy-duty vehicles differ from light-duty vehicles.

In this section, we will characterize the heavy-duty GHG emissions inventory, broadly discuss the technologies available in the near- and long-term to reduce heavy-duty truck GHG emissions, and discuss potential regulatory options to address these emissions. We invite comment on the issues that are relevant to the considering potential GHG emission standards for heavy-duty trucks. In particular, we invite commenters to

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[139] Government Accountability Office. *Freight Transportation: National Policy and Strategies Can Help Improve Freight Mobility* GAO-08-287. Report to the Ranking Member, Committee on Environment and Public Works, US Senate. January 2008.

compare and contrast potential heavy-duty solutions to our earlier discussion of light-duty vehicles and our existing heavy-duty criteria pollutant control program in light of the differences between GHG emissions and traditional criteria air pollutants.

a. Heavy-Duty Truck GHG Emissions

Heavy-duty on-road vehicles emitted 401 million metric tons of CO_2 emissions in 2006, or approximately 19% of the mobile source CO_2 emissions, the largest mobile source sub-category after light-duty vehicles.[140] CO_2 emissions from these vehicles are expected to increase significantly in the future, by approximately 29% between 2006 and 2030.[141]

Diesel powered trucks comprise 91% of the heavy-duty CO_2 emissions, with the remaining 9% coming from gasoline and natural gas engines. Heavy-duty GHG emissions come primarily from two types of applications, combination and single unit trucks. Combination trucks constitute 75% of the total heavy-duty GHG emissions -- 44% from long-haul and 31% from short-haul operations. Short-haul single unit trucks are the third largest source at 19%. The remaining 5% consists of long-haul single unit trucks; intercity, school, and transit buses; refuse trucks, and motor home emissions.[142]

[140] Emissions data in this section are from the United States Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006*. EPA 430-R-08-005. April 2008.
[141] Growth data in this section is from United States Department of Energy, Energy Information Administration. *Annual Energy Outlook 2008*. #DOE/EIA-0383. April 2008.
[142] Breakdown of emissions data in this section is from United States Environmental Protection Agency. MOVES model. April 8, 2008.

GHG emissions from heavy-duty trucks are dominated by CO_2 emissions, which comprise approximately 99% of the total, while hydrofluorocarbon and $N_2$0 emissions represent 0.5% and 0.3%, respectively, of the total emissions on a CO_2 equivalent basis.

b. Potential for GHG Emissions Reductions from Heavy-Duty Trucks

Based on the work from EPA's SmartWay Transport Partnership and the 21st Century Truck Partnership, we see a potential for up to a 40% reduction in GHG emissions from a typical heavy-duty truck in the 2015 timeframe, with greater reductions possible looking beyond 2015, through improvements in truck and engine technologies.[143] While highly effective criteria pollutant control has been realized based on engine system regulation alone, the following sections make clear that GHG emissions improvements to truck technology provide a greater potential for overall GHG emission reductions from this sector.

In this section, we will provide a brief summary of the potential for GHG emission reductions in terms of engine technology, truck technology and changes to fleet operations. The public docket for this Advance Notice includes a technical memorandum from EPA staff summarizing this potential in greater detail.[144] In discussing the potential for CO_2 emission reductions, it can be helpful to think of work flow through the a truck's system. The initial work input is fuel. Each gallon of diesel fuel has the potential to produce some amount of work and will produce a set amount of CO_2 (about 22 lbs. of

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[143] 21st Century Truck Partnership. *Technology Roadmap for the 21st Century Truck Program*. 21CT-001. December 2000. http://www.doe.gov/bridge

[144] Summary of GHG Emission Control Technologies For Heavy-Duty Trucks, Memorandum To Docket XXX May 2008

CO_2 per gallon of diesel fuel). The engine converts the chemical energy in the fuel to useable work to move the truck. Any reductions in work demanded of the engine by the vehicle or improvements in engine fuel conversion efficiency will lead directly to CO_2 emission reductions. Current diesel engines are about 35% efficient over a range of operating conditions with peak efficiency levels of a little over 40%. This means that approximately one-third of the fuel's chemical energy is converted to useful work and two-thirds is lost to waste heat in the coolant and exhaust. In turn, the truck uses this work output from the engine to overcome vehicle aerodynamic drag (53%), tire rolling resistance (32%), and friction in the vehicle driveline (6%) and to provide auxiliary power for components such as air conditioning and lights (9%).[145] While it may be intuitive to look first to the engine for CO_2 reductions given that only about one-third of the fuel is converted to useable work, it is important to realize that any improvement in vehicle efficiency reduces both the work demanded and also the energy wasted in proportional amounts.

In evaluating the potential to reduce GHG emissions from trucks and operations as a whole, it will be important to develop an appropriate metric to quantify GHG emission reductions. As discussed above, our current heavy-duty regulatory programs measure emissions expressed on a mass per work basis (g/bhp-hr). This approach has proven highly effective at controlling criteria pollutant emissions while normalizing the diverse range of heavy-duty vehicle applications to a single engine-based test metric. While such an approach could be applied to evaluate CO_2 emission reductions from heavy-duty engines, it would not readily provide a mechanism to measure and compare

[145] Approximate truck losses at 65 mph from 21st Century Truck Partnership. *21st Century Truck Partnership Roadmap/Technical White Papers: Engine Systems*. 21CT-003. December 2006. http://www.doe.gov/bridge

reductions due to vehicle improvements. Hence, we will need to consider other performance metrics such as GHG emissions per ton-mile. We request comment on what types of metrics EPA should consider to measure and express GHG emission rates from heavy-duty trucks.

We discuss below the wide range of engine, vehicle, and operational technologies available to reduce GHG emissions from heavy-duty trucks. Our discussion broadly assesses the availability of these technologies and their GHG emissions reduction potential. We request comment on all aspects of our current assessment summarized here and in more detail in our technical memorandum, including supporting data with regard to technology costs, GHG reduction effectiveness, the appropriate GHG metric to evaluate the technology and the timeframe in which these technologies could be brought into the truck market. More generally, we request comment on the overall GHG emissions reductions that can be achieved by heavy-duty trucks in the 2015 and 2030 timeframes.

i. Engine

The majority of heavy-duty vehicles today utilize turbocharged diesel engines. Diesel engines are more efficient compared to gasoline engines due to the use of higher compression ratios, the ability to run with lean air-fuel mixtures, and the ability to run without a throttle for load control. Modern diesel engines have a peak thermal efficiency of approximately 42%, compared to gasoline engines that have a peak thermal efficiency of 30%. Turbochargers increase the engine's power-to-weight ratio and recover some of the exhaust heat energy to improve the net efficiency of the engine.

Additional engine improvements could increase efficiency through combustion improvements and reductions of parasitic and pumping losses. Increased cylinder pressure, waste heat recovery, and low viscosity lubricants could reduce CO_2 emissions, but are not widely utilized in the heavy-duty industry. Individual improvements have a small impact on engine efficiency, but a combination of approaches could increase efficiency by 20% to achieve a peak engine efficiency of approximately 50%.[146]

Waste heat recovery technologies, such as Rankine bottoming cycle, turbocompounding and thermoelectric materials, can recover and convert engine waste heat to useful energy, leading to improvements in the overall engine thermal efficiency and consequent reduction in CO_2 emissions. We request comment on the potential of these technologies to lower both GHG emissions and overall heavy-duty vehicle operating costs.

In section VI.D below, we discuss the Renewable Fuel Standard (RFS) program and more broadly the overall role of fuel changes to reduce GHG emissions. As we have previously noted, the Agency has addressed vehicle emissions through a systems-based approach that integrates consideration of fuel quality and vehicle or engine emission control systems. For example, removing lead from gasoline and sulfur from diesel fuel has enabled the introduction of very clean gasoline and diesel engine emission control technologies. A systems approach may be a means to address GHG emissions as well.

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[146] 21st Century Truck Partnership. *21st Century Truck Partnership Roadmap/Technical White Papers: Engine Systems*. 21CT-003. December 2006. http://www.doe.gov/bridge

Since 1989, European engine maker Scania has offered an ethanol powered heavy-duty diesel cycle engine with traditional diesel engine fuel efficiency (the current version offers peak thermal efficiency of 43%).[147] Depending on the ethanol production pathway, such an approach could offer a significant reduction in GHG emissions from a life cycle perspective when compared to more traditional diesel fuels. We request comment on the potential for a systems approach considering alternate fuel and engine technologies to reduce GHG emission from heavy-duty trucks. We also request comment on how EPA might structure a program to appropriately reflect the potential for such GHG emission reductions.

ii. Vehicle systems

An energy audit of heavy-duty trucks shows that vehicle efficiency is strongly influenced by systems outside of the engine. As noted above, aerodynamics, tire rolling resistance, drivetrain, and weight are areas where technology improvements can significantly reduce GHG emissions through reduced energy losses. The fuel savings benefits of many of these technologies often offset the additional costs. Opportunities for HFC and additional CO_2 reductions are available through improved air conditioning systems.

For a typical combination tractor-trailer truck traveling at 65 mph, energy losses due to aerodynamic drag can total over 21% of the total energy consumed.[148] A recent study between industry and the federal government demonstrated that reducing the

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[147] Green Car Congress. *Scania Extending Heavy-Duty Ethanol Engine Technology to Trucks*. April 15, 2008. http://www.greencarcongress.com/2008/04/scania-extendin.html (April 30, 2008).
[148] 21st Century Truck Partnership. *Technology Roadmap for the 21st Century Truck Program*. 21CT-001. December 2000. http://www.doe.gov/bridge

tractor-trailer gap and adding trailer side skirts, trailer boat tails, and aerodynamic mirrors can reduce aerodynamic drag by as much as 23%. If aerodynamic drag were reduced from 21% to 15% (a 23% reduction), GHG emissions at 65 mph would be reduced by almost 12%.[149] The cost of aerodynamic equipment installed on a new or existing trailer is generally paid back within two years.[150] As aerodynamic designs become more sophisticated, more consistency in how aerodynamics is measured is needed. There is no single, consistent approach used by industry to measure the coefficient of aerodynamic drag of heavy trucks. As a result, it is difficult for fleets to understand which truck configurations have the lowest aerodynamic drag. We request comment on the best approach to evaluate aerodynamic drag and the impact of aerodynamic drag on truck GHG emissions.

For a typical combination tractor-trailer truck traveling at 65 mph, energy losses due to tire rolling resistance can total nearly 13% of the total energy consumed.[151] Approximately 80-95% of the energy losses from rolling resistance occur as the tire flexes and deforms when it meets the road surface, due to viscoelastic heat dissipation in the rubber. For heavy trucks, a 10% reduction in rolling resistance can reduce GHG emissions by 1-3%.[152] Improvements of this magnitude and greater have already been demonstrated, and continued innovation in tire design has the potential to achieve even larger improvements in the future. Specifying single wide tires on a new combination

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[149] United States Department of Energy, Lawrence Livermore National Laboratory. *Working Group Meeting on Heavy Vehicle Aerodynamic Drag: Presentation, Summary of Contents and Conclusion*. UCRL-TR-214683. May 2005.

[150] Bachman, L. Joseph,; Anthony Erb; Cheryl Bynum. *Effect of Single Wide Tires and Trailer Aerodynamics on Fuel Economy and NOx Emissions of Class 8 Line-Haul Tractor-Trailers*. SAE Paper 2005-01-3551. 2005.

[151] 21st Century Truck Partnership. *Technology Roadmap for the 21st Century Truck Program*. 21CT-001. December 2000. http://www.doe.gov/bridge

[152] 21st Century Truck Partnership. *Technology Roadmap for the 21st Century Truck Program*. 21CT-001. December 2000. http://www.doe.gov/bridge

truck can have a lower initial cost and lead to immediate fuel savings.[153] Despite the well-understood benefits of lower rolling resistance tires, manufacturers differ in how they assess tire rolling resistance. We seek comment on the potential for low rolling resistance tires to lower GHG emissions, the need for consistent protocols to measure tire rolling resistance, and the need for a common ranking or rating system to provide tire rolling resistance information to the trucking industry.

Hybrid technologies, both electric and hydraulic, offer significant GHG reduction potential. The hybrid powertrain is a combination of two or more power sources: an internal combustion engine and a second power source with an energy storage and recovery device. Trucks operating under stop-and-go conditions, such as urban delivery trucks and refuse trucks, lose a significant amount of energy during braking. In addition, engines in most applications are designed to perform under a wide range of requirements and are often oversized for the majority of their requirements. Hybrid powertrain technologies offer opportunities to capture braking losses and downsize the engine for more efficient operation. We invite comment on the potential of GHG reductions from hybrids in all types of heavy-duty applications.

Currently most truck auxiliaries, such as the water pump, power steering pump, air conditioning compressor, air compressor and cooling fans, are mechanical systems typically driven by belts or gears off of the engine driveshaft. The auxiliary systems are inefficient because they produce power proportionate to the engine speed regardless of the actual vehicle requirements and require conversion of fuel energy to electrical or mechanical work. If systems were driven by electrical systems they could be optimized

[153] United States Environmental Protection Agency. *A Glance at Clean Freight Strategies: Single Wide-Based Tires*. EPA420-F-04-004. February 2004.

for actual requirements and reduced energy consumption. We request comment on the potential for these auxiliary systems to lower GHG emissions from heavy-duty trucks.

Air conditioning systems are responsible for GHG emissions from refrigerant leakage and from the exhaust emissions generated by the engine to produce the load required to run the air conditioning. The emissions due to leakage can be reduced by the use of improved sealing designs, low-permeation hoses, and refrigerant substitution. Replacing today's refrigerant, HFC-134a, which has a high global warming potential (GWP=1,300), with HFC-152a (GWP=120) or CO_2 (GWP=1) reduces the impact of the air conditioning leakage on the environment.[154] The load requirements of the air conditioning system can be reduced through the use of improved condensers, evaporators, and variable displacement compressors. We request comment on the impact of air conditioning improvements on GHG reductions in heavy-duty trucks.

iii. Operational

The operation of the truck, including idle time and vehicle speed, also has significant impact on the GHG emissions. Technologies that improve truck operation exist and provide benefits to owners through reduced fuel costs.

Idling trucks emit a significant amount of CO_2 emissions (as well as criteria pollutants). On average, a typical truck will emit 18 pounds of CO_2 per hour of idling.[155] Long haul truck idle reduction technologies can reduce main engine idling while still

[154] Frey, H. Christopher and Po-Yao Kuo. *Best Practices Guidebook for GHG Emissions Reductions in Freight Transportation.* Prepared for U.S. Department of Transportation via Center for Transportation and the Environment. October 2007. Pages 26-27.
[155] United States Environmental Protection Agency. *A Glance at Clean Freight Strategies: Idle Reduction*. EPA420-F-04-009. February 2004.

meeting cab comfort needs. Some idle reduction technologies have no upfront cost for the truck owner and hence represent an immediate savings in operating costs with lower GHG emissions. Other idle reduction technologies pay back within three years.[156] In addition to providing information about these systems, EPA seeks comment on whether it should work with stakeholders to develop a formal evaluation protocol for the effectiveness, cost, durability, and operability of various idle-reduction technologies.

Vehicle speed is the single largest operational factor affecting CO_2 emissions from large trucks. A general rule of thumb is that every mph increase above 55 mph increases CO_2 emissions by more than 1%. Speed limiters are generally available on new trucks or as a low-cost retrofit, and assuming a five mph decrease in speed, payback occurs within a few months.[157]

Automatic tire inflation systems maintain proper inflation pressure, and thereby reduce tire rolling resistance. Studies indicate that automatic tire inflation systems result in about 0.5 to 1% reduction of CO_2 emissions for a typical truckload or less-than-truckload over-the-road trucking fleet.[158] Automatic tire inflation systems can pay back in less than four years, assuming typical underinflation rates.

All of the technologies summarized here can provide real GHG reductions while providing value to the truck owner through reduced fuel consumption. We request comment on the potential of these specific technologies and on any other technologies that may allow vehicle operators to reduce overall GHG emissions.

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[156] EPA SmartWay Transport Partnership, *Technology Package Savings Calculator,* http://www.epa.gov/smartway/calculator/loancalc.htm.

[157] American Trucking Associations *Petition to National Highway Traffic Safety Administration*, (Docket NHTSA-2007-26851, Document ID NHTSA-2007-26851-0005), October 20, 2006, and American Trucking Associations *Comment to Docket* (Docket NHTSA-2007-26851, Document ID NHTSA-2007-26851-3708), March 27, 2007.

[158] Emission reduction and payback information from United States Environmental Protection Agency. *A Glance at Clean Freight Strategies: Automatic Tire Inflation Systems.* EPA420-F-04-010. February 2004.

c. Regulatory Options for Reducing GHGs from Heavy-Duty Trucks

In developing any GHG program for heavy-duty vehicles, we would rely on our past experience addressing the multifaceted characteristics of this sector. In the following sections, we discuss three potential regulatory approaches for reducing GHG emissions from the heavy-duty sector. We request comments on all aspects of these options. We also encourage commenters to suggest other approaches that EPA should consider to address GHG emissions from heavy-duty trucks, recognizing that there are some important differences between criteria air pollutants and GHG emissions.

The heavy-duty engine manufacturers have made great strides in reducing criteria pollutant emissions. We know these same manufacturers have already achieved GHG emission reductions through the introduction of more efficient engine technologies, and have the potential to realize even greater reductions. We estimate that approximately 30% of the overall GHG emission reduction potential from this sector comes from engine improvements, 60% from truck improvements, and 10% from operational improvements based on the technologies outlined in the 21^{st} Century Truck roadmap and *Best Practices Guidebook for GHG Emissions Reductions in Freight Transportation*. We request comment on our assessment of the relative contributions of engine, truck, and operational technologies.

The first approach we could consider would be a regulatory program based on an engine CO_2 standard or weighted GHG standard including N_2O and methane. One advantage to this option is its simplicity because it preserves the current regulatory and market structures. The heavy-duty engine manufacturers are familiar with today's certification testing and procedures. They have facilities, engine dynamometers, and test equipment to appropriately measure emissions. The same equipment and test procedures can be, and already are, used to measure CO_2 emissions. Measuring and reporting N_2O and methane emissions would require relatively simple additions to existing test cell instrumentation. We request comment regarding issues that EPA should consider in evaluating this option and the most appropriate means to address the issues raised. We recognize that an engine-based regulatory structure would limit the potential GHG emission reductions compared to programs that include vehicle technologies and the crediting of fleets for operational improvements. The other approaches considered below would have the potential to provide greater GHG reductions by providing mechanisms to account for vehicle and fleet operational changes.

Recognizing that GHG emissions could be further reduced through improvements to both engines and trucks, we request comment on an alternative test procedure that would include vehicle aspects in an engine-based standard. This option would still be based on an engine standard. However, it would provide a mechanism to adjust the engine test results to account for improvements in vehicle design. For example, if through an alternate test procedure (e.g., a vehicle chassis test) a hybrid truck were shown to reduce GHG emissions by 20%, under this option an engine based GHG test result could be adjusted downward by that same 20%. In this way, we could reflect a range of vehicle or perhaps even operational changes into an engine based regulatory program. In fact, we are already developing such an approach for a vehicle based change to provide a better mechanism to evaluate criteria emissions from hybrid vehicles.[159] We are

[159] As discussed in section VI.C.2, we have also applied a similar alternate test procedure approach in our new locomotive standards (see 40 CFR 1033.530(h)).

currently working with the heavy-duty industry to develop these new alternate test procedures and protocols. These new procedures could provide a foundation for regulatory programs to address GHG emissions as well. We request comment on the potential for alternate test procedures to reflect vehicle technologies in an engine based GHG regulatory program.

A second potential regulatory option for heavy-duty truck GHG emissions would be to follow a model very similar to our current light-duty vehicle test procedures. Each truck model could be required to meet a GHG emissions standard based on a specified drive cycle. The metric for the standard could be either a weighted GHG gram/mile with prescribed test weight and payload or GHG gram/payload ton-mile to recognize that heavy-duty trucks perform work. This option would reflect an important change from our current regulatory approach for most heavy-duty vehicles by direct regulation of trucks (and therefore truck manufacturers) rather than engines.[160] As discussed earlier in this section, we have historically regulated heavy-duty engines rather than vehicles reflecting in part the heavy-duty industry structure and in part the preeminence of engine technology in controlling NO_x and PM emissions. Clearly truck design plays a much more important role in controlling GHG emissions due to significant energy losses through aerodynamic drag and tire rolling resistance, and therefore, this option directly considers the regulation of heavy-duty trucks. We request comment on all aspects of this option including the appropriate test metric, the need to develop new test procedures and potential approaches for grouping heavy-duty vehicles into subcategories for GHG regulatory purposes.

[160] For some years EPA has allowed gasoline and other non-diesel vehicle manufactures to certify to and comply with a vehicle based standard as compared to en engine based standard, at their option. See, e.g. 40 CFR 86.005-10.

As described earlier, there are a number of technologies and operational changes that heavy-duty fleet operators can implement to reduce both their overall operating costs and their GHG emissions. Therefore, a third regulatory option that could be considered as a complement to those discussed previously would be to allow heavy-duty truck fleets to generate GHG emissions credits for applying technologies to reduce GHG emissions, such as idle reduction, vehicle speed limiters, air conditioning improvements, and improved aerodynamic and tire rolling resistance. In order to credit the use of such technologies, EPA would first need to develop procedures to evaluate the potential for individual technologies to reduce GHGs. Such a procedure could be based on absolute metrics (g/mile or g/ ton-mile) or relative metrics (percent reductions). We would further need to address a wide range of complex potential issues including mechanisms to ensure that the reductions are indeed realized in use and that appropriate assurance of such future actions could be provided at the time of certification, which occurs prior to the sale of the new truck. Such a regulatory program could offer a significant opportunity to reward trucking fleets for their good practices while providing regulatory flexibility to help address the great diversity of the heavy-duty vehicle sector. It would not lead to any additional GHG reductions, however, as the credits generated by the fleet operators would be used by the engine or vehicle makers to comply with their standards. We welcome comments on the merits and issues surrounding potential approaches to credit operational and technical changes from heavy-duty fleets to reduce GHG emissions.

In considering the regulatory options available, we are cognizant of the significant burden that could result if these programs were to require testing of every potential engine and vehicle configuration related to its GHG emissions. Therefore, we have been following efforts in Japan to control GHG emissions through a regulatory program that relies in part on engine test data and in part on vehicle modeling simulation. As currently constructed, Japan's heavy-duty fuel efficiency regulation considers engine fuel consumption, transmission type, and final drive ratio in estimating overall GHG emissions. Such a modeling approach may be a worthwhile first step and may be further improved by including techniques to recognize design differences in vehicle aerodynamics, tire rolling resistance, weight, and other factors. We request comment on the appropriateness of combining emissions test data with vehicle modeling results to quantify and regulate GHG emissions. In particular, we welcome comments addressing issues including model precision, equality aspects of model based regulation, and the ability to standardize modeling inputs.

The regulatory approaches that we have laid out in this section reflect incremental steps along a potential path to fully address GHG emissions from this sector. These approaches should not be viewed as discrete options but rather as potential building blocks that could be mixed and matched in an overall control program. Given the potential for significant burden, EPA is also interested in considering how flexibilities such as averaging, banking, and/or credit trading that may help to reduce costs may be built into any of the regulatory options discussed above. We request comment on all of the approaches described in this section and the potential to implement one or more of these approaches in a phased manner to capture the more straightforward approaches in the near-term and the more complex approaches over a longer period.

3. Highway Motorcycles

The U.S. motorcycle fleet encompasses a vast array of types and styles, from small and light scooters with chainsaw-sized engines to large and heavy models with engines as big as those found in many family sedans. In 2006 approximately 850,000 highway motorcycles were sold in the U.S., reflecting a near-quadrupling of sales in the last ten years. Even as motorcycles gain in popularity, their overall GHG emissions remain a relatively small fraction of all mobile source GHG emissions. Most motorcycles are used recreationally and not for daily commuting, and use is seasonally limited in much of the country. For these reasons and the fact that the fleet itself is relatively small, total annual vehicle miles traveled for highway motorcycles is about 9.5 billion miles (as compared to roughly 1.6 trillion miles for passenger cars).[161]

The Federal Highway Administration reports that the average fuel economy for motorcycles in 2003 was 50 mpg, almost twice that of passenger cars in the same time frame. However, motorcycles are generally designed and optimized to achieve maximum performance, not maximum efficiency. As a result, many high-performance motorcycles have fuel economy in the same range as many passenger cars despite the smaller size and weight of motorcycles. Recent EPA emission regulations are expected to reduce fuel use and hence GHG emissions from motorcycles by: (1) leading manufacturers to increase the use of electronic fuel injection (replacing carburetors); (2) reducing permeation from fuel lines and fuel tanks; and (3) eliminating the use of two-stroke engines in the small scooter category. [162]

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[161] "Highway Statistics 2003," U.S. Department of Transportation, Federal Highway Administration, Table VM-1, December 2004.
[162] See 69 FR 2398, January 15, 2004.

There may be additional opportunities for further reductions in GHG emissions. Options available to manufacturers may include incorporating more precise feedback fuel controls; controlling enrichment on cold starts and under load by electronically controlling choke operation; allowing lower idle speeds when the opportunity exists; optimizing spark for fuel and operating conditions through use of a knock sensor; and, like light-duty vehicles, reducing the engine size and incorporating a turbo-charger. The cost of these fuel saving and GHG reducing technologies may be offset by the fuel savings realized over the lifetime of the motorcycle.

We request comment on information on what approaches EPA should consider for potential further reductions in GHG emissions from motorcycles. We also request comment and data regarding what technologies may be applicable to achieve further GHG reductions from motorcycles.

C. Nonroad Sector Sources

As discussed previously, CAA section 213 provides broad authority to regulate emissions from a wide array of nonroad engines and vehicles, [163] while CAA section 211 provides authority to regulate fuels and fuel additives from both on-highway and nonroad sources and CAA section 231 authorizes EPA to establish emissions standards for aircraft. Collectively, the Title II nonroad and

[163] The Act does not define "vehicle", but we have interpreted section 213 from its inception to include the broad array of equipment, machines, and vessels powered by nonroad engines, including those that are not self-propelled, such as portable power generators. In keeping with common usage, we typically use the generic terms "equipment", "machine", or "application", as well as the more application-specific terms "vehicle" and "vessel", to refer to these units, as appropriate.

fuel regulation programs developed by EPA over the past two decades provide a possible model for how EPA could structure a long-term GHG reduction program for nonroad engines and vehicles, fuels and aircraft.

In this section, we first review and request comment on a number of petitions received by EPA requesting action to regulate GHG emissions from these sources and we highlight the similarities and key issues raised in those petitions. We invite comment on all of the questions and issues raised in these petitions. For each of three primary groupings, nonroad, marine, and aircraft, we then discuss and seek comment on the GHG emissions from these sources and the opportunities to reduce GHG emissions through design and operational changes.

1. Petition Summaries

Since the Massachusetts decision, EPA has received seven additional petitions requesting that we make endangerment findings and undertake rulemaking procedures using our authority under CAA sections 211, 213 and 231 to regulate GHG[164] emissions from fuels, nonroad sources, and aircraft. The petitioners represent states, local governments, environmental groups, and nongovernmental organizations (NGO) including the states of California, New Jersey, New Mexico, Friends of the Earth, NRDC, OCEANA, International Center for Technology Assessment, City of New York, and the South Coast Air Quality Management District. Copies of these seven petitions can be found in the

[164] While petitioners vary somewhat in their definition of GHGs, collectively they define carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, water vapor, sulfur hexaflouride, and soot or black carbon as GHGs.

docket for this Advance Notice. Following is a brief summary of these petitions. We request comment on all issues raised by the petitioners.

a. Marine Engine and Vessel Petitions

The Agency has received three petitions to reduce GHG emissions from ocean-going vessels (OGVs). California submitted its petition on October 3, 2007. A joint petition was filed on the same day by EarthJustice on behalf of three environmental organizations: Oceana, Friends of the Earth and the Center for Biological Diversity ("Environmental Petitioners"). A third petition was received from the South Coast Air Quality Management District (SCAQMD) on January 10, 2008.

The California petition requests that EPA immediately begin the process to regulate GHG emissions from Category 3 powered OGVs.[165] According to the petition, the Governor of California has already recognized that, "California is particularly vulnerable to the impacts of climate change," including the negative impact of increased temperature on the Sierra snowpack, one of the State's primary sources of water, and the further exacerbation of California's air quality problems.[166] The petition outlines the steps California has already taken to reduce its own contributions to global warming and states that it is petitioning the

[165] A category 3 vessel is one where the main propulsion engine(s) have a per-cylinder displacement of more than 30 liters.
[166] State of California, Petition for Rulemaking Seeking the Regulation of Greenhouse Gas Emissions from Ocean – Going Vessels, page3, October 3, 2007 ("California Petition").

Administrator to take action to regulate GHG emissions from OGVs because it believes national controls will be most effective.

California makes three key points in its petition. First, California claims that EPA has clear authority to regulate OGV GHG emissions under CAA section 213 (a) (4). The State points out that the "primary substantive difference" between CAA section 202(a)(1), which the Supreme Court found authorizes regulation of GHGs emissions from new motor vehicles upon the Administrator making a positive endangerment finding, and section 213 is that section 202(a)(1) requires regulation if such an endangerment finding is made while section 213(a)(4) authorizes, but does not require, EPA to regulate upon making the requisite endangerment finding. But petitioner states that EPA's discretion to decide whether to regulate OGVs under section 213(a)(4) is constrained in light of the overall structure and purpose of the CAA. Citing the Massachusetts decision, California asserts that the Supreme Court has "set clear and narrow limits on the kinds of reasons EPA may advance for declining to regulate significant sources of GHGs".

The second claim California makes is that international law does not bar regulation of GHG emissions from foreign-flagged vessels by the U.S. California asserts that U.S. laws can operate beyond U.S. borders (referred to as extra-territorial operation of laws) when the conduct being regulated affects the U.S. and where Congress intended such extra-territorial application.[167] Petitioner believes that such application of the CAA is both "permissible and essential in

[167] Petitioners cite EEOC v. Arabian American Oil Co., 499 U.S. 244 (1991) ("Aramco") as supporting this principle.

this case" because to effectively control GHG emissions from shipping vessels, the EPA must regulate foreign-flagged vessels since they comprise 95% of the fleet calling on U.S. ports.[168] Petitioner cites two other instances where the U.S. has regulated foreign-flagged vessels. First, in Specto v. Norwegian Cruiseline. 545 U.S. 119 (2005), the Supreme Court held that the Americans with Disabilities Act (ADA) could be applied to foreign-flagged cruise ships that sailed from U.S. ports as long as the required accommodations for disabled passengers did not require major, permanent modification to the ships involved. Second, the National Park Service recently imposed air pollutant emissions controls on cruise ships, including foreign-flagged cruise ships that sail off the coast from Glacier Bay National Park, Alaska. The petitioner points out that in this case they did so to protect and preserve the natural resources of the Park, which is analogous to California's reasons for why EPA must regulate GHG emissions from foreign-flagged vessels.[169]

The third claim raised in California's petition is that technology is currently available to reduce GHG emissions from these vessels, either through NOx reductions or by reducing fuel consumption. Options include, using marine diesel fuel oil instead of bunker fuel, using selective catalytic reductions and exhaust gas recirculation or by reducing speed. Petitioner states that the Clean Air Act was intended to be a technology-forcing statute and that EPA can and should consider OGV control measures that force the development of new technology.

[168] California Petition, page 13.
[169] Petitioners cite regulations found at 36 C.F.R. '13.65 (b)(4) and 61 FR 27008, at 27011.

California requests three forms of relief: (1) that EPA make a finding that carbon dioxide emissions from new marine engines and vessels significantly contribute to air pollution which may reasonably be anticipated to endanger public health and welfare; (2) that EPA use its CAA section 213 (a) (4) authority to adopt regulations specifying emissions standards for CO_2 emissions from these engines and vessels; and (3) that EPA adopt regulations specifying fuel content or type necessary to carry out the emission standards adopted for new marine engines.

The second group requesting EPA action on OGVs, Environmental Petitioners, believes that climate change threatens public health and welfare and that marine shipping vessels make a significant contribution to GHG emissions, and that therefore EPA should quickly promulgate regulations requiring OGVs to meet emissions standards by "operating in a fuel-efficient manner, using cleaner fuels and/or employing technical controls, so as to reduce emissions of carbon dioxide, nitrous oxide, and black carbon." These petitioners further state that EPA should also control "the manufacture and sale of fuels used in marine shipping vessels by imposing fuel standards" to reduce GHG emissions.[170]

The Environmental Petitioners focus their petition on four specific arguments. First, like California, they assert that OGVs play a significant role in global climate change. They focus on the emissions of four pollutants: CO_2, NOx, N_20, and black carbon (also known as soot). Petitioners cite numerous studies that they assert document that the impact of these GHG emissions are

[170] Environmental Petition, Petition for Rulemaking Under the Clean Air Act to Reduce the Emissions of Air Pollutants from Marine Shipping Vessels that Contribute to Global Climate Change, page 2, October 3, 2007,

significant today and that industry trends indicate these emissions will grow substantially in future decades. Second, petitioners lay out a detailed legal argument asserting that EPA has clear authority to regulate these four air pollutants from OGVs, and contending that the Massachusetts decision must guide EPA's actions as it decides how to regulate GHG emissions from OGVs. Third, petitioners discuss a number of regulatory measures that can effectively reduce GHG emissions from OGVs and which EPA could adopt using its regulatory authority under CAA section 213 (a)(4), including measures requiring restrictions on vessel speed; requiring the use of cleaner fuels in ships and other technical and operations measures petitioners believe are relatively easy and cost-effective. Lastly, petitioners assert that the CAA section 213 provides EPA with clear authority to regulate GHG emissions from both new and remanufactured OGV engines as well as from foreign-flagged vessels.

SCAQMD petition also requests Agency action under section 213 of the CAA and states that it has a strong interest in the regulation of GHG emissions from ships including emissions of NOx, PM, and CO_2. SCAQMD states that the net global warming effect of NOx emissions is potentially comparable to the climate effect from ship CO_2 emissions and that PM emissions from ships in the form of black carbon can also increase climate change. [171] Finally, because international shipping activity is increasing yearly, SCAQMD asserts that if EPA dos not act quickly, future ship pollution will become even worse, increasing both ozone and GHG levels in the South Coast area of California. As with other

[171] SCAQMD, Petition for Rulemaking under the Clean Air Act to Reduce Global Warming Pollutants from Ships, page 2, January 10, 2008.

petitioners, SCAQMD states that there is a clear legal basis for EPA to regulate ships GHG emissions under section 213 (a) (4).

SCAQMD makes two additional assertions in its petition which mirror the California and Environmental Petitions. First, EPA can avoid regulation of ship GHG emissions only if it determines that "endangerment" can be avoided without regulation of ship emissions.[172] Second, SCAQMD believes that EPA has the authority to regulate foreign-flagged vessels under at least two circumstances: (1) for a foreign owned and operated vessel, where the regulation(s) would not interfere with matters that "involve only the internal order and discipline of the vessel," Spector v. Norwegian Cruise Lines, 545 U.S. 119, 131 (2005), and (2) where the vessel is owned and operated by a U.S. corporation, even if it is foreign-flagged.[173]

SCAQMD requests two types of relief: (1) that EPA, within six months of receiving its petition, make a positive endangerment determine for CO_2, NOx, and black carbon emissions from new marine engines and vessels "because of their contribution to climate change;" and (2) that EPA promulgate regulations under CAA section 213 (a)(4) to obtain the maximum feasible reductions in emissions of these pollutants. We invite comment on all elements of the petitioners' assertions and requests.

b. Aircraft Petitions

[172] SCAQMD Petition, page 9.
[173] SCAQMD Petition, page10.

The Agency has received two petitions to reduce GHG emissions from aircraft.[174] The first petition was submitted on December 4, 2007, by California, Connecticut, New Jersey, New Mexico, Pennsylvania's Department of Environmental Protection, the City of New York, the District of Columbia, and the SCAQMD ("State Petitioners"). A second petition was filed on December 31, 2007, by Earthjustice on behalf of four environmental organizations: Friends of the Earth, Oceana, Center for Biological Diversity and NRDC ("Environmental Petitioners").

All petitioners request that EPA exercise its authority under section 231(a) of the CAA to regulate GHG emissions from new and existing aircraft and/or aircraft engine operations, after finding that aircraft GHG emissions cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare.[175] Petitioners suggest that these regulations could allow compliance through technological controls, operational measures, emissions fees, or a cap-and-trade system.

Both petitions discuss how aircraft engines emit GHG emissions which they assert have a disproportionate impact on climate change. Petitioners cite a range of scientific documents to support their statements. They assert that

[174] While aircraft engines are not "nonroad engines" as defined in CAA section 216(10) and aircraft are not "nonroad vehicles" as defined in CAA section 216(11), such that aircraft could be subject to regulation under CAA section 213, for organizational efficiency we include aircraft in this "Nonroad Sector Sources" section of today's notice.

[175] Petitioners maintain that aircraft engine emissions of CO_2, NOx, water vapor, carbon monoxide, oxides of sulfur, and other trace components including hydrocarbons such as methane and soot contribute to global warming and that in 2005, aircraft made up 3% of U.S. CO_2 emissions from all sectors, and 12% of such emissions from the transportation sector. States of California et al, Petition for Rulemaking Seeking the Regulation of Greenhouse Gas Emissions from Aircraft, page 11, December 4, 2007, and Friends of the Earth et al, Petition for Rulemaking under the Clean Air Act to Reduce the Emissions of Air Pollutants from Aircraft that Contribute to Global Climate Change, pages 6-7, December 31, 2007.

ground-level aircraft NOx, a compound they identify as a GHG, contributes to the formation of ozone, a relatively short-lived GHG. NOx emissions in the upper troposphere and tropopause, where most aircraft emissions occur, result in greater concentrations of ozone in those regions of the atmosphere compared to ground level ozone formed as a result of ground level aircraft NOx emissions. Petitioners contend that aircraft emissions contribute to climate change also by modifying cloud cover patterns. Aircraft engines emit water vapor, which petitioners identify as a GHG that can form condensation trails, or "contrails," when released at high altitude. Contrails are visible line shaped clouds composed of ice crystals that form in cold, humid atmospheres. Persistent contrails often evolve and spread into extensive cirrus cloud cover that is indistinguishable from naturally occurring cirrus clouds. The petitioners state that over the long term this contributes to climate change.

State Petitioners highlight the effects climate change will have in California and the City of New York as well as efforts underway in both places to reduce GHG emissions. They argue that without federal government regulation of GHG emissions from aircraft, their efforts at mitigation and adaptation will be undermined. Both petitioners urge quick action by EPA to regulate aircraft GHG emissions since these emissions are anticipated to increase considerably in the coming decades due to a projected growth in air transport both in the United States and worldwide. They cite numerous reports to support this point, including an FAA report, which indicates that by 2025 emissions of CO_2 and NOx from domestic aircraft are expected to increase by 60%.[176]

We request comment on all issues raised in the petitions, particularly on two assertions made by Environmental Petitioners: (1) that technology is available to reduce GHG emissions from aircraft allowing EPA to take swift action, and (2) that EPA has a mandatory duty to control GHG emissions from aircraft and can fulfill this duty consistent with international law governing aircraft. In addition, we invite comment on the petitioners' assessment of the impact of aircraft GHG emissions on climate change, including the scientific understanding of these impacts, and whether aircraft GHG emissions cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare.

With regard to technology, petitioners highlight existing and developing aviation procedures and technologies which could reduce GHG emissions from new and existing aircraft. For example, they point to various aviation operations and procedures including minimizing engine idling time on runways and employing single engine taxiing that could be undertaken by aircraft to reduce GHG emissions. Petitioners also discuss the availability of more efficient aircraft designs to reduce GHG emissions, such as reducing their weight, and they suggest that using alternative fuels could also reduce aviation GHG emissions.

Environmental Petitioners contend that once EPA makes a positive endangerment finding for aircraft GHG emissions, EPA has a mandatory duty to act, but that the potential regulatory responses available to EPA are quite broad

[176] FAA, Office of Environment and Energy, *Aviation and Emission: A Primer*, January 2005, page 10, available at http://www.faa.gov/regulations_policies/policy_guidance/envir_policy/media/aeprimer.pdf .

and should be considered for all classes of aircraft, including both new and in-use aircraft and aircraft engines. In addition, petitioners argue that EPA's authority to address GHG emissions from aircraft is consistent with international law—in particular the Convention on International Civil Aviation (the "Chicago Convention") -- and that the United States' obligations under the Convention do not constrain EPA's authority to adopt a program that addresses aviation's climate change impacts, including those from foreign aircraft.

The State and Environmental Petitioners each request the following relief: (1) that EPA make an explicit finding under CAA section 231(a)(2)(A) that GHG emissions from aircraft cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare; (2) that EPA propose and adopt standards for GHG emissions from both new and in-use aircraft as soon as possible; (3) that EPA adopt regulations that allow a range of compliance approaches, including emissions limits, operations practices and/or fees, a cap-and-trade system, as well as measures that are more near-term, such as reduced taxi time or use of ground-side electricity measures. The Environmental Petitioners' also request that EPA issue standards 90 days after proposal. We invite comment on all elements of the petitioners' assertions and requests, as well as the scientific and technical basis for their assertions and requests.

c. Nonroad Engine and Vehicle Petitions

On January 29, 2008, EPA received two petitions to reduce GHG emissions from nonroad engines and vehicles. The first petition was submitted by California, Connecticut, Massachusetts, New Jersey and Oregon and Pennsylvania's Department of Environmental Protection ("State Petitioners"). The second petition was submitted by the Western Environmental Law Center on behalf of three nongovernmental organizations: the International Center for Technology Assessment, Center for Food Safety, and Friends of the Earth ("NGO Petitioners").

Both petitions request that EPA exercise its authority under CAA section 213(a) (4) to adopt emissions standards to control and limit GHG emissions from new nonroad engines excluding aircraft and vessels. Both petitions seek EPA regulatory action on a wide range of nonroad engines and equipment, which the petitioners believe, contribute substantially to GHG emissions, including outdoor power equipment, recreational vehicles, farm and construction machinery, lawn and garden equipment, logging equipment and marine vessels.[177]

The State Petitioners, mirroring the earlier State petitions on ocean-going vessels and aircraft, describe the harms which they believe will occur due to climate change, including reduced water supplies, increased wildfires, and threats to agricultural outputs in California; loss of coastal wetlands, beach erosion, saltwater intrusion of drinking water in Massachusetts and Connecticut; and similar harms to the Pennsylvania, New Jersey and Oregon. The petition

[177] The two petitions request that EPA regulate slightly different categories of nonroad engines and vehicles under CAA section 213. State Petitioners exclude from their request aircraft, locomotives and ocean-going vessels and do not include rebuilt heavy-duty engines. The *NGO Petitioners* exclude only aircraft and ocean-going vessels but also request that EPA use its CAA section 202 authority to regulate GHG emissions from rebuilt heavy-duty engines.

highlights actions that California has already taken to reduce its own contributions to global warming but points out that only EPA has authority to regulate emissions from new farm and construction equipment under 175 horsepower, "which constitutes a sizeable portion of all engines in this category...."[178]

The State Petitioners present three claims which, they believe compel EPA action to reduce GHG emissions from nonroad sources. First, petitioners claim that GHG emissions from these sources are significant. [179] Petitioners cite various reports documenting national GHG emissions from a broad range of nonroad categories which, they contend, provide evidence that nonroad GHG emissions are already substantial, and will continue to increase in the future. Petitioners, also cite additional inventory reports that nonroad GHG emissions already exceed total U.S. GHG emissions from aircraft as well as from boats and ships, rail, and pipelines combined.[180] Petitioner's present California nonroad GHG emissions data which, they contend, mirror national GHG emission trends for nonroad engines and bolster their claim that GHG emissions from the nonroad sector, as a whole, are significant and are substantial for three categories: construction and mining equipment, agricultural, and industrial equipment.

State Petitioners' second claim is that EPA has the authority to regulate GHG emissions from nonroad sources, although they acknowledge that CAA section 213 (a)(4) is discretionary. Petitioners contend this discretion is not

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[178] States Petition for Nonroad, page 7-8.
[179] Petitioners indicate that in 2007, non-transportation mobile vehicles and equipment were responsible for approximately 220 million tons of CO_2 emissions (data derived from EPA's Nonroad Emissions model for 2007). State of California et al, Petition for Rulemaking Seeking the Regulation of Greenhouse Gas Emissions from Nonroad Vehicles and Engines, page 8, January 29, 2008, and International Center for Technology Assessment et al, Petition for Rulemaking Seeking the Regulation of Greenhouse Gas Emissions from Nonroad Vehicles and Engines, page 5, January 29, 2008.
[180] State Petition for Nonroad, page 9.

unlimited and that the structure of the CAA must guide EPA's actions. Petitioners maintain that since the CAA prohibits States from undertaking their traditional police power role in regulating pollution from new construction or agricultural sources under 175 horsepower, "Congress has implicitly invested EPA with the responsibility to act to prevent [these] harmful emissions." The third and final claim raised by State Petitioners is that both physical and operational controls are currently available to achieve fuel savings and/or to limit GHG emissions. Such measures include idle reduction, electrification of vehicles, the use of hybrid or hydraulic-hybrid technology, as well as use of "cool paints" that reduce the need for air conditioning.

NGO petitioners make three similar claims in their petition. First, petitioners argue that serious public health and environmental consequences are projected for this century unless effective and timely action is taken to mitigate climate change. Petitioners further contend that GHG emissions from nonroad engines and vehicles are responsible for a significant and growing amount of GHG emissions and, like the State petitioners previously, they highlight three nonroad sectors responsible for a large portion of these GHG emission – construction, mining, and agriculture.

Petitioners' second claim is that once EPA renders a positive endangerment determination under CAA section 202 for motor vehicles and engines, this finding should also satisfy the endangerment determination required under CAA section 213(a)(4) for nonroad engines. EPA's discretion under CAA section 213 (a) (4) is limited, petitioners assert, by the relevant statutory considerations, as held by the Supreme Court in Massachusetts v. EPA, so that the Agency "can decline to regulate nonroad engine and vehicle emissions only if EPA determines reasonably that such emissions do not endanger public health or welfare, or else, taking into account factors such as cost, noise, safety and energy, no such regulations would be appropriate."[181] Like State petitioners, NGOs point out that because the CAA restricts states' ability to regulate pollution from new construction or farm vehicles and engines under 175 horsepower, Congress "implicitly invested EPA with unique responsibility to act in the states' stead so as to prevent such harmful emissions." Petitioners also argue that the National Environment Policy Act (NEPA) section 101(b) compels EPA action to fulfill its duty "as a trustee of the environment for succeeding generations."

NGO Petitioners' third claim is that a wide range of technology is currently available to reduce GHG emissions from nonroad engines and vehicles and that, in addition, the CAA was intended to be a technology-forcing statute so that EPA "can and should" establish regulations that "substantially limit GHG emissions.... even where those regulations force the development of new technology." Regarding technology availability, petitioners provide a list of technologies that they believe are currently available to reduce GHG emissions from nonroad vehicles and engines, including auxiliary power unit systems to avoid engine use solely to heat or cool the cab; tire inflation systems; anti-idling standards; use of hybrid or hydraulic-hybrid technology; use of low carbon fuels; and use of low viscosity lubricants.

[181] *NGO Petition*, page 8.

Both State and NGO Petitioners request three types of relief: (1) that EPA make a positive endangerment determination for GHG emissions from nonroad vehicles and engines[182]; (2) that EPA adopt regulations to reduce GHG emissions from this sector; and (3) that regulations necessary to carry out the emissions standards also be adopted.[183] We invite comment on all of the petitioners' assertions and requests.

2. Nonroad Engines and Vehicles

In this section, we discuss the GHG emissions and reduction technologies that are or may be available for the various nonroad engines and vehicles that are the subject of the petitioners described above. Since section 213 was added to the CAA in 1990,the Agency has completed a dozen major rulemakings which established program that reduce traditional air pollutants from nonroad sources by over 95%, benefitting local, regional, and national air quality. EPA's approach has been to set standards based on technology innovation, with flexibility for the regulated industries to meet environmental goals through continued innovation that can be integrated with marketing plans.

With help from industry, environmental groups and state regulators, EPA has designed nonroad regulatory programs that have resulted in significant air quality gains with little sacrifice of products' ability to serve their purpose. In fact, manufacturers have

[182] In addition, NGO petitioner also request that EPA make a determination under CAA section 202 (a)(3)(D) that GHG emissions from rebuilt heavy-duty engines also are significant contributors to air pollution which may reasonably be anticipated to endanger public health and welfare. NGO Petition, page 11.

[183] State petitioners indicate that adopting regulations specifying fuel type, for example, may be necessary to carry out the emission limitations.

generally added new features and performance improvements that are highly desirable to users. Because GHG reductions from nonroad sources can be derived from fuel use reductions that directly benefit the user's bottom line, we expect that manufacturers' incentive to increase the fuel efficiency of their produces will be even stronger in the future. This potential appears higher for nonroad engines compared to highway engines because in the past energy consumption has been less of a focus in the nonroad sector, so there may be more opportunity for improvement, while at the same time higher fuel prices are now beginning to make fuel expenses more important to potential equipment purchasers.

The Agency and regulated industries have in the past grouped nonroad engines in a number of ways. The first is by combustion cycle, with two primary cycles in use: compression-ignition (CI) and spark-ignition (SI). The combustion cycle is closely linked to grouping by fuel type, because CI engines largely burn diesel fuel while SI engines burn gasoline or, for forklifts and other indoor equipment, liquefied petroleum gas (LPG). It has also been useful to group nonroad engines by application category. Regulating nonroad engine application categories separately has helped the Agency create effective control programs, due to the nonroad sector's tremendous diversity in engine types and sizes, equipment packaging constraints, affected industries, and control technology opportunities. Although for the sake of discussion we use these application groupings, we solicit comment on what grouping engines and applications would make the most sense for GHG regulation, especially if flexible emissions credit and averaging concepts are pursued across diverse applications.

a. Nonroad Engine and Vehicle GHG Emissions

Nonroad engines emitted 249 million metric tons of CO_2 in 2006, 12% of the total mobile source CO_2 emissions.[184] CO_2 emissions from the nonroad sector are expected to increase significantly in the future, approximately 46% between 2006 and 2030. Diesel engines emit 71% of the total nonroad CO_2 emissions. The other 29% comes from gasoline, LPG, and some natural gas-fueled engines. CO_2 emissions from individual nonroad application categories in decreasing order of prominence are: nonroad diesel (such as farm tractors, construction and mining equipment), diesel locomotives, small SI (such as lawn mowers, string trimmers, and portable power generators), large SI (such as forklifts and some construction machines), recreational marine SI, and recreational offroad SI (such as all terrain vehicles and snowmobiles).

GHG emissions from nonroad applications are dominated by CO_2 emissions which comprise approximately 97% of the total. Approximately 3% of the GHG emissions (on a CO_2 equivalent basis) from nonroad applications are due to hydrofluorocarbon emissions, mainly from refrigerated rail transport. Methane and N_2O make up less than 0.2% of the nonroad sector GHG emissions on a CO_2 equivalent basis. Much of the following discussion focuses on technology opportunities for CO_2 reduction, but we note that these technologies will generally reduce N_2O and methane emissions as well, and we ask for comment on measures and options for specifically addressing N_2O and methane emissions.

[184] Emissions data in this section are from *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006*. EPA 430-R-08-005. April 2008, and EPA NONROAD2005a model.

b. Potential for GHG Reductions from Nonroad Engines and Vehicles

The opportunity for GHG reductions from the nonroad sector closely parallels the highway sector, especially for the heavy-duty highway and nonroad engines that share many design characteristics. In addition, there is potential for significant further GHG reductions from changes to vehicle and equipment characteristics. A range of GHG reduction opportunities is summarized in the following discussion. Comment is requested on these opportunities and on additional suggestions for reducing GHGs from nonroad sources.

It should be noted that any means of reducing the energy requirements necessary to power a nonroad application can yield the desired proportional reductions of GHGs (and other pollutants as well). Although in past programs, the Agency has typically focused on a new engine’s emissions per unit of work, such as gram/brake horsepower-hour (g/bhp-hr), it may prove more effective to achieve GHG reductions by redesigning the equipment or vehicle that the engine powers so that the nonroad application accomplishes its task while expending less energy. Improvements such as these do not show up in measured g/bhp-hr emissions levels, but would be reflected in some other metric such as grams emitted by a locomotive in moving a ton of freight one mile.

EPA solicits comment on possible nonroad GHG emissions reduction strategies for the various “pathways” by which GHGs can be impacted. Although it is obvious that internal combustion engines emit GHGs via the engine exhaust, it is helpful to take the analysis to another level by putting it in the context of energy use and examining the pathways by which energy is expended in a nonroad application, such as through vehicle braking. Because of the diversity of nonroad applications, we are taking a different approach here than in other sections of this notice: first, we summarize some of the engine, equipment, and operational pathways and opportunities for GHG reductions that are common to all or at least a large number of nonroad applications; next, we examine more closely just one of the hundreds of nonroad applications, locomotives, to illustrate the many additional application-specific pathways for GHG reductions that are available. Our assessment is that, despite the great diversity in nonroad applications, technology-based solutions exist for every application to achieve cost-effective and substantial GHG emissions reductions.

i. Common GHG Reduction Pathways

To ensure that this advance notice initiates the widest possible discussion of potential GHG control solutions, the following discussion includes all three types of possible control measures: engine, equipment, and operational.

(1) Engine pathways

To date, improving fuel usage in many nonroad applications has not been of great concern to equipment users and therefore to designers. There is potential for technologies now fairly commonplace in the highway sector, such as advanced lubricants and greater use of electronic controls, to become part of an overall strategy for GHG emissions reduction in the nonroad sector. We welcome comment on the opportunities and limitations of doing so.

One engine technology in particular warrants further discussion. Two-stroke gasoline engines have been popular especially in handheld lawn care applications and recreational vehicles because they are fairly light and inexpensive. However, they also produce more GHGs than four-stroke engines. Much progress has been made in recent years in the development of four-stroke engines that function well in these applications. We ask for comment on the extent to which a shift to four-stroke engines would be feasible and beneficial.

Although today's nonroad gasoline and diesel engines produce significantly less GHGs than earlier models, further improvements are possible. Engine designers are continuing to work on new designs incorporating technologies that produce less GHGs, such as homogeneous charge CI, waste heat recovery through turbo compounding, and direct fuel injection in SI engines. Most of this work has already been done for the automotive sector where economies of scale can justify the large investments. Much of this innovation can eventually be adapted to nonroad applications, as has occurred in the past with such technologies as electronic fuel injection and common rail fueling. We therefore request comment on the feasibility and potential for these advanced highway sector technologies, discussed in section VI.B, to be introduced or accelerated in the nonroad sector.

(2) Equipment and operational pathways

Technology solutions in both the equipment design and operations can reach beyond the engine improvements to further reduce GHG emissions. We broadly discuss the following technologies below: regenerative energy recovery and hybrid power trains, CVT transmissions, air conditioning improvements, component design improvements, new lighting technologies, reduced idling, and consumer awareness.

Locomotives, as an example, have significant potential to recover energy otherwise dissipated as heat during braking. An 8,000-ton coal train descending through 5,000 feet of elevation converts 30 MW-hrs of potential energy to frictional and dynamic braking energy. Storing that energy onboard quickly enough to keep up with the energy generation rate presents a challenge, but may provide a major viable GHG emissions reduction strategy even if only partially effective. Another regenerative opportunity relates to the specific, repetitive, predictable work tasks that many nonroad machines perform. For example, a forklift in a warehouse may lift a heavy load to a shelf and in doing so expend work. Just as often, the forklift will lower such a load from the shelf, and recover that load's potential energy, if a means is provided to store that energy on board.

There are, however, many nonroad applications that may not have much potential for regenerative energy recovery (a road grader, for example), but in those applications a hybrid diesel-electric or diesel-hydraulic system without a regenerative component may still provide some GHG benefits. A machine that today is made with a large engine to handle occasional peak work loads could potentially be redesigned with a smaller engine and battery combination sized to handle the occasional peak loads.

Besides pre-existing electrical or hydraulic systems, some nonroad applications have one additional advantage over highway vehicles in assessing hybrid prospects: they often have quite predictable load patterns. A hybrid locomotive, for example, can be assigned to particular routes, train sizes, and consist (multi-locomotive) teams, to ensure it is used as close to full capacity as possible. The space needs of large battery banks could potentially be accommodated on a tender car, and the added weight would be offset somewhat by a smaller diesel fuel load (typically 35,000 lbs today) and dynamic brake grid. At least one locomotive manufacturer, General Electric, is already developing a hybrid design, and battery energy storage has been demonstrated for several years in rail yard switcher applications.

We request comment on all aspects of the hybrid and regeneration opportunity in the nonroad sector, including the extent to which the electric and hydraulic systems already designed into many nonroad machines and vehicles could provide some cost savings in implementing this technology, and the extent to which plug-in technologies could be used in applications that have very predictable downtime such as overnight at construction sites, or that can use plug-in electric power while working or while sitting idle between tasks.

A Continuously Variable Transmission (CVT) has an advantage over other conventional transmission designs by allowing the engine to operate at its optimum speed over a range of vehicle speeds and typically over a wider range of available ratios, which can provide GHG emission reductions. It has been estimated that CVTs can provide a 3 to 8% decrease in fuel use over 4-speed automatic transmissions.[185] They are already in

[185] "Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards," National Research Council, National Academy of Sciences, 2002.

use some in nonroad vehicles such as snowmobiles and all-terrain vehicles, and could possibly be used in other nonroad applications as well. We request comment on the opportunities to apply CVT to various nonroad applications.

Some nonroad applications have air conditioning or refrigeration equipment, including large farm tractors, highway truck transport refrigeration units (TRUs), locomotives, and refrigerated rail cars. Reducing refrigerant leakage in the field or reducing its release during maintenance would work to reduce GHG emissions In addition, a switch to refrigerants with lower GHG emissions than the currently-used fluorinated gases can have a significant impact. We expect that the measures used to reduce nonroad equipment refrigerant GHGs would most likely involve the same strategies that have been or could be pursued in the highway and stationary source sectors, and the reader is referred to section VI.B.1 for additional discussion. We request comment on the degree to which nonroad applications emit fluorinated gases, and on measures that may be taken to reduce these emissions.

An extensive variety of energy-consuming electrical, mechanical, and hydraulic accessories are designed into nonroad machines to help them perform their tasks. Much of the energy output of a nonroad engine passes through these components and systems in making the machine do useful work, and all of them have associated energy losses through bearing friction, component heating, and other pathways. Designing equipment to use components with lower GHG impacts in these systems can yield substantial overall reductions in GHG emissions.

Some nonroad applications expend significant energy in providing light, such as locomotive headlights and other train lighting. Furthermore, diesel-powered portable light towers for highway construction activities at night are increasingly being used to reduce congestion from daytime lane closures. We request comment on the extent to which a switch to less energy-intensive lighting could reduce GHG emissions.

Many nonroad diesel engines are left idling during periods when no work is demanded of them, generally as a convenience to the operator, though modern diesel engines are usually easy to restart. In some applications this may occupy hours every day. Even though the hourly fuel rate is fairly low during idle, in the past several years railroads have saved considerable money by adding automatic engine stop start (AESS) systems to locomotives. These monitor key parameters such as state of battery charge, and restart the engine only as needed, thereby largely eliminating unnecessary idling. They reduce GHG emissions and typically pay for themselves in fuel savings within a couple of years. Our recent locomotive rule mandated these systems for all new locomotives as an emission control measure (40 CFR 1033.115(g)). AESS or similar measures may be feasible for other nonroad applications with significant idling time as well. We request comment on the availability and effectiveness of nonroad idle reduction technologies.

ii. Application-specific GHG pathways

As mentioned above, we discuss application-specific approach for further reducting GHG emissions from one nonroad application, locomotives, to illustrate application-specific opportunities for GHG emission reductions beyond those discussed above that apply more generally. We note that some of these application-specific opportunities, though limited in breadth, may be among the most important, because of their large GHG reduction potential.

We have chosen locomotives for this illustration in part because rail transportation has already been the focus of substantial efforts to reduce its energy use, resulting in generally favorable GHG emissions per ton-mile or per passenger-mile. The Association of American Railroads calculates that railroads move a ton of freight 423 miles on one gallon of diesel fuel.[186] Reasons for the advantage provided by rail include the use of medium-speed diesel engines, lower steel-on-steel rolling resistance, and relatively gradual roadway grades. Rail therefore warrants attention in any discussion on mode-shifting as a GHG strategy. Even if GHG emissions reduction were not at issue, shippers and travelers already experience substantial mode-shift pressure today from long-term high fuel prices. Growth in the rail sector highlights the critical importance of locomotive GHG emissions reduction.

We have listed some key locomotive-specific opportunities below. We note that a number of these are aimed at addressing GHG pathways from rail cars. Rail cars create very significant GHG reduction pathways for locomotives, because all of the very large energy losses from railcar components translate directly into locomotive fuel use. This is especially important when one considers that an average train has several dozen cars. We request comment on the feasibility of the ideas on this list and on other possible ways to reduce GHG emissions.

<u>Opportunities for Rail GHG Reduction</u>

Locomotives

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[186] Comments of the Association of American Railroads on EPA's locomotive and marine engine proposal, July 2, 2007. Available in EPA docket EPA-HQ-OAR-2003-0190.

- Low-friction wheel bearings
- Aerodynamic improvements
- Idle emissions control beyond AESS (such as auxiliary power units)
- Electronically-controlled pneumatic (ECP) brakes
- High-adhesion trucks (wheel assemblies)
- Global positioning system (GPS)-based speed management (to minimize braking, over-accelerations, and run-out/run-in losses at couplings)

Railcars

- Low-torque rail car wheel bearings
- Tare weight reduction
- Aerodynamic design of rail cars and between-car gaps
- Better insulated refrigeration cars

Rail Infrastructure

- Application of lubricants or friction modifiers to minimize wheel-to-track friction losses
- Higher-speed railroad crossings
- Targeted-route electrification
- Rail yard infrastructure improvements to eliminate congestion and idling

Operational

- Consist manager (automated throttling of each locomotive in a consist team for lowest overall GHG emissions)
- Optimized GPS-assisted dispatching/routing/tracking of rail cars and locomotives

- Optimized matching of locomotives with train load for every route (including optimized placement of each locomotive along the train)
- Expanded resource sharing among railroads
- Reduction of empty-car trips
- Early scrappage of higher- GHG locomotives

c. Regulatory Options for Nonroad Engines and Vehicles

There is a range of options that could be pursued under CAA section 213 to control nonroad sector GHGs. The large diversity in this sector allows for a great number of technology solutions as discussed above, while also presenting some unique challenges in developing a comprehensive, balanced, and effective regulatory program, and highlights the importance of considering multiple potential regulatory strategies. We have met similar challenges in regulating traditional air pollutants from this sector, and we request comment on the regulatory approaches discussed below and whether they would address the challenges of regulating GHGs from nonroad engines.

As discussed in our earlier section on heavy-duty vehicles, the potential regulatory approaches that we discuss here should be considered not as discrete options but as a continuum of possible approaches to address GHG emissions from this sector. Just as we have in our technology discussion, these regulatory approaches begin with the engine and then expand to included potential approaches to realize reductions through vehicle and operational changes. In approaching the discussion in this way, each step along such a path has the potential to greater regulatory complexity but also has the potential for greater regulatory flexibility, GHG reduction, and program benefits. For large GHG reductions in the long term we expect to give consideration to approaches that accomplish the largest reductions, but we also note that, given the long time horizons for GHG issues, we can consider a number of incremental regulatory steps along a longer path. Also, given the absence of localized effects associated with GHG emissions, EPA is interested in considering the incorporation of banking, averaging, and/or credit trading into the regulatory options discussed below.

The first regulatory approach we consider is a relatively straightforward extension of our existing criteria pollutant program for nonroad engines. In its simplest form, this approach would be an engine GHG standard that preserves the current regulatory structure for nonroad engines. Nonroad engine manufacturers are already familiar with today's certification testing and procedures. Just like the highway engine manufacturers, they have facilities, engine dynamometers, and test equipment to appropriately measure GHG emissions. Further, technologies developed to reduce GHG emissions from heavy-duty engines could be applied to the majority of diesel nonroad engines with additional development to address differences in operating conditions and engine applications in nonroad equipment. Hence, this approach would benefit from both regulatory work done to develop a heavy-duty engine GHG program and technology development for heavy-duty engines to comply with a GHG program. While we do not expect that new test cycles would be needed to effect meaningful GHG emissions control, we request comment on whether new test cycles would allow for improved control, and especially on whether there are worthwhile GHG control technologies that would not be adequately exercised and measured under the current engine test cycles and test procedures.

A second approach that would extend control opportunities beyond engine design improvements involves developing nonroad vehicle and equipment GHG standards. Changes to nonroad vehicles and equipment can offer significant opportunity for GHG emission reductions, and therefore any nonroad GHG program considered by EPA would need to evaluate the potential for reductions not just from engine changes but from vehicle and equipment changes as well. In section VI.B.2 we discussed a potential heavy-duty truck GHG standard (e.g., a gram per mile or gram per ton-mile standard). A similar option could be considered for at least some portion of nonroad vehicles and equipment. For example, a freight locomotive GHG standard could be considered on a similar mass per ton mile basis. This would be a change from our current mass per unit work approach to locomotive regulation, but section 213 of the Clean Air Act does authorize the Agency to set vehicle-based and equipment-based nonroad standards as well.

However, we are concerned that there may be significant drawbacks to widespread adoption of this application-specific standards-setting approach. For the freight locomotive example given above, a gram per ton-mile emissions standard measured over a designated track route might be a suitable way to express a GHG standard, but such a metric would not necessarily be appropriate for other applications. Instead each application could require a different unit of measure tied to the machine's mission or output-- such as grams per kilogram of cuttings from a "standard" lawn for lawnmowers and grams per kilogram-meter of load lift for forklifts. Such application-specific standards would provide the clearest metric for GHG emission reductions. The standards would directly reflect the intended use of the equipment and would help drive equipment and engine designs that most effectively meet that need while reducing overall GHG emissions. However, the diversity of tasks performed by the hundreds of nonroad applications would lead to a diverse array of standard work units and measurement techniques in such a nonroad GHG program built on equipment-based standards. We request comments on this second regulatory approach, and in particular comments that identify specific nonroad applications that would be best served by such a nonroad vehicle-based regulatory approach.

A variation on the above-described approaches would be to maintain the relative simplicity of an engine-based standard while crediting the GHG emission reduction potential of new equipment designs. Under this option, the new technology would be evaluated by measuring GHG emissions from a piece of equipment that has the new technology while performing a standard set of typical tasks. The results would then be compared with data from the same or an identical piece of equipment, without the new technology, performing the same tasks. This approach could be carried out for a range of equipment models to help improve the statistical case for the resulting reductions. The percentage reduction in GHG emissions with and without the new equipment technology could then be applied to the GHG emissions measured in certification testing of engines used in the equipment in helping to demonstrate compliance with an engine-based GHG standard. Thus if a new technology were shown to reduce the GHG emissions of a typical piece of equipment by 20%, that 20% reduction could be applied at certification to the GHG emission results from a more traditional engine-based test procedure and engine-based standard.

In fact, a very similar approach has been adopted in EPA's recently established locomotive program (see 73 FR 25155, May 6, 2008). In this provision, credit is given to energy-saving measures based on the fact that they provide proportional reductions in the criteria pollutants. This credit takes the form of an adjustment to criteria pollutant emissions measured under the prescribed test procedure for assessing compliance with engine-based standards.

A more flexible extension of this approach would be to de-link the equipment-based GHG reduction from the compliance demonstration for the particular engine used in the same equipment. Instead the GHG difference would provide fungible credits for each piece of equipment sold with the new technology, credits that then could be used in a credit averaging and trading program. Under this concept it would be important to collect and properly weight data over an adequate range of equipment and engine models, tasks performed, and operating conditions, to ensure the credits are deserved. We request comments on the option of applying the results of equipment testing to an engine-based GHG standard and the more general concept of generating GHG emission credits from such an approach. We also request comment on whether such credit-based approaches to accounting for the many promising equipment measures are likely to obtain similar GHG reductions as the setting of equipment-based standards, and on whether some combined approach involving both standards and credits may be appropriate.

There are also a number of ways to reduce GHG emissions in the nonroad sector that do not involve engine or equipment redesign. Rather, reductions can be achieved by altering the way in which the equipment is used. For example, intermodal shipping moving freight from trucks and onto lower GHG rail or marine services, provides a means of reducing these emissions for freight shipments that can accommodate the logistical constraints of intermodal shipping. Many of the operational measures with GHG-reducing potential do involve a significant technology component, perhaps even hardware changes, but they can also involve actions on the part of the equipment operator or owner that go beyond simply maintaining and not tampering with the emission controls. For example, a railroad may make the capital and operational investment in sophisticated computer technology to dispatch and schedule locomotive resources, using onboard GPS-based tracking hardware. The GHG reduction benefit, though enabled in part by the onboard hardware, is not realized without the people and equipment assigned to the dispatch center.

Credit for such operational measures could conceivably be part of a nonroad GHG control program and could be calculated and assigned using the same “with and without” approach to credit generation described above for equipment-based changes. However, some important implementation problems arise from the greater human element involved. This human element becomes increasingly significant as the scope of creditable measures moves further away from automatic technology-based solutions. Assigning credits to such measures must involve good correlation between the credits generated and the GHG reductions achieved in real world applications. It therefore may make sense to award these credits only after an operational measure has been implemented and verified as effective. This might necessitate that such credits have value for equipment or sources other than the equipment associated with the earning of the credit, such as in a broader credit market. This is because nonroad equipment and engines must demonstrate compliance with EPA standards before they are put into service. They therefore cannot benefit from credits created in the future unless through some sort of credit borrowing mechanism.

Once verified, however, we would expect credits reflecting these operational reductions could be banked, averaged and traded, just as much as credits derived from equipment- or engine-based measures. Verifiable GHG reductions, regardless of how generated, have equal value in addressing climate change. We also note, however, that an effective credit program, especially one with cross-sector utility, should account for the degree to which a credit-generating measure would have happened anyway, or would have happened eventually, had no EPA program existed; this is likely to be challenging. We request comment on the appropriateness of a much broader GHG credit-based program as described here.

In this section, we have laid out a range of regulatory approaches for nonroad equipment that takes us from a relatively simple extension of our existing engine-based regulatory program through equipment based standards and finally to a fairly wide open credit scheme that would in concept at least have the potential to pull in all aspects of nonroad equipment design and operation. In describing these approaches, we have noted the increasing complexity and the greater need for new mechanisms to ensure the emission reductions anticipated are real and verifiable. We seek comment on the relative merits of each of these approaches but also on the potential for each approach along the continuum to build upon the others.

3. Marine Vessels

Marine diesel engines range from very small engines used to propel sailboats, or used for auxiliary power, to large propulsion engines on ocean-going vessels. Our current marine diesel engine emission control programs distinguish between five kinds of marine diesel engines, defined in terms of displacement per cylinder. These five types include small (≤37 kW), recreational, and commercial marine engines. Commercial marine engines are divided into three categories based on per cylinder displacement: Category 1 engines are less than 5 l/cyl, Category 2 engines are from 5 l/cyl up to 30 l/cyl, and Category 3 engines are at or above 30 l/cyl. Category 3 engines are 2- or 4-stroke propulsion engines that typically use residual fuel; this fuel has high energy content but also has very high fuel sulfur levels that result in high PM emissions. Most of the other engine types are 4-stroke and can be used to provide propulsion or auxiliary power. These operate on distillate fuel although some may operate on a blend of distillate and residual fuel or even on residual fuel (for example, fuels commonly known as DMB, DMC, RMA, and RMB).

There are also a wide variety of vessels that use marine diesel engines and they can be distinguished based on where they are used. Vessels used on inland waterways and coastal routes include fishing vessels that may be used either seasonally or throughout the year, river and harbor tug boats, towboats, short- and long-distance ferries, and offshore supply and crew boats. These vessels often have Category 2 or smaller engines and operate in distillate fuels. Ocean-going vessels (OGVs) include container ships, bulk carriers, tankers, and passenger vessels and have Category 3 propulsion engines as well as some smaller auxiliary engines. As EPA deliberates on how to potentially address GHG emissions from marine vessels, we will consider the significance of the different engine, vessel, and fuel types. We invite comment on the marine specific issues that EPA should consider; in particular, we invite commenters to compare and contrast potential marine vessel solutions to our earlier discussions of highway and nonroad mobile sources and our existing marine engine criteria pollutant control programs.

a. Marine Vessel GHG Emissions

Marine engines and vessels emitted 84.2 million metric tons of CO_2 in 2006, or 3.9 percent of the total mobile source CO_2 emissions. CO_2 emissions from marine vessels are expected to increase significantly in the future, more than doubling between 2006 and 2030. The emissions inventory from marine vessels comes from operation in ports, inland waterways, and offshore. The CO_2 inventory estimates presented here refer to emissions from marine engine operation with fuel purchased in the United States.[187] OGVs departing US ports with international destinations take on fuel that emits 66 percent of the marine vessel CO_2 emissions; the other 34 percent comes from smaller commercial and recreational vessels.

GHG emissions from marine vessels are dominated by CO_2 emissions which comprise approximately 94 percent of the total. Approximately 5.5 percent of the GHG emissions from marine vessels are due to HFC emissions, mainly from reefer vessels (vessels which carry refrigerated containers). Methane and nitrous oxide make up less than 1 percent of the marine vessel sector GHG emissions on a CO_2 equivalent basis.

[187] U.S. EPA, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006," April 15, 2008.

Comment is requested on the contribution of marine vessels to GHG emissions and on projections for growth in this sector.

b. Potential for GHG Reductions from Marine Vessels

There are significant opportunities to reduce GHG emissions from marine vessels through both traditional and innovative strategies. These strategies include technological improvements to engine and vessel design as well as changes in vessel operation. This section provides an overview of these strategies, and a more detailed description is available in the public docket.[188] EPA requests comment on the advantages and drawbacks of each of the strategies described below, as well as on additional approaches for reducing greenhouse gases from marine vessels.

i. Reducing GHG emissions through marine engine changes

GHG emissions may be reduced by increasing the efficiency of the marine engine. As discussed earlier for heavy-duty trucks, there are a number of improvements for CI engines that may be used to lower GHGs. These improvements include higher compression ratios, higher injection pressure, shorter injection periods, improved turbocharging, and electronic fuel and air management. Much of the energy produced in a CI engine is lost to the exhaust. Some of this energy can be reclaimed through the use of heat recovery systems. We request comment on the feasibility of reducing GHG

[188] "Potential Technologies for GHG Reductions from Commercial Marine Vessels", memorandum from Michael J. Samulski, U.S. EPA, to docket xx, DATE.

emissions through better engine designs and on additional technology which could be used to achieve GHG reductions.

As discussed above, marine engines are already subject to exhaust emission standards. Many of the noxious emissions emitted by internal combustion engines may also be GHGs. These pollutants include NOx, methane, and black carbon soot. Additionally, some strategies used to mitigate NOx and PM emissions can also indirectly impact GHGs through their impact on fuel use -- for example, use of aftertreatment rather than injection timing retard to reduce NOx emissions. We request comment on the GHG reductions associated with HC+NOx and PM emissions standards for these engines.

The majority of OGVs operate primarily on residual fuel, while smaller coastal vessels operate primarily on distillate fuel. Shifting more shipping operation away from residual fuel would reduce GHG emissions from the ship due to the lower carbon/hydrogen ratio in distillate fuel. Marine engines have been developed that operate on other lower carbon fuels such as natural gas and biodiesel. Because biodiesel is a renewable fuel, lifecycle GHG emissions are much lower than for operation on petroleum diesel. We request comment on these and other fuels that may be used to power marine vessels and the impact these fuels would have on lifecycle GHG emissions.

A number of innovative alternatives are under development for providing power on marine vessels. These alternative power sources include fuel cells, solar power, wind power, and even wave power. While none of these technologies are currently able to supply the total power demands of larger, ocean-going vessels, they may prove to be capable of reducing GHG emissions through auxiliary power or power-assist applications. Hybrid engine designs are used in some vessels where a bank of engines is used to drive electric motors for power generation. The advantage of this approach is that the same engines may be used both for propulsion and auxiliary needs. Another advantage is that alternative power sources could be used with a hybrid system to provide supplemental power. We request comment on the extent to which alternative power sources and hybrid designs may be applied to marine vessels to reduce greenhouse gases.

ii. Reducing GHG emissions through vessel changes

GHG emissions may be reduced by minimizing the power needed by the vessels to perform its functions. The largest power demand is generally for overcoming resistance as the vessel moves through the water but is also affected by propeller efficiency and auxiliary power needs.

Water resistance is made up of the effort to displace water and drag due to friction on the hull. The geometry of the vessel may be optimized in many ways to reduce water resistance. Ship designers have used technologies such as bulbous bows and stern flaps to help reduce water resistance from the hull of the vessel. Marine vessels typically use surface coatings to inhibit the growth of barnacles or other sea life that would increase drag on the hull. Innovative strategies for reducing hull friction include coatings with textures similar to marine animals and reducing water/hull contact by enveloping the hull with small air bubbles released from the sides and bottom of the ship.

Both the wetted surface area and amount of water displaced by the hull may be reduced by lowering the weight of the vessel. This may be accomplished through the use of lower weight materials such as aluminum or fiberglass composites or by simply using less ballast in the ship when not carrying cargo. Other options include ballast-free ship designs such as constantly flowing water through a series of pipes below the waterline or a pentamaran hull design in which the ship is constructed with a narrow hull and four sponsons which provide stability and eliminate the need for ballast water. We request comment to the extent that these approaches may be used to reduce GHGs by reducing fuel consumption from marine vessels in the future. We also request comment on other design changes that may reduce the power demand due to resistance on the vessel.

In conventional propeller designs, a number of factors must be considered including load, speed, pitch, diameter, pressure pulses, and cavitation (formation of bubbles which may damage propeller and reduce thrust). Proper maintenance of the propeller can minimize energy losses due to friction. In addition, propeller coatings are available that reduce friction on the propeller and lead to energy savings. Because of the impact of the propeller on the operation of the vessel, a number of innovative technologies have been developed to increase the efficiency of the propeller. These technologies include contra-rotating propellers, azimuth thrusters, ducted propellers, and grim vane wheels. We request comment on the GHG reductions that may be achieved through improvements in vessel propulsion efficiency, either through the approaches listed here or through other approaches.

Power is also needed to provide electricity to the ship and to operate auxiliary equipment. Power demand may be reduced through the use of less energy intensive lighting, improved electrical equipment, improved reefer systems, crew education campaigns, and automated air-conditioning systems. We request comment on the opportunities to provide auxiliary power with reduced GHG emissions.

In addition, GHG emissions may be released from leaks in air conditioning or refrigeration systems. There is a large amount of fluorinated and chlorinated hydrocarbons used in refrigeration and air-conditioning systems on ships. We request comment on the degree to which marine vessels emit fluorinated and chlorinated hydrocarbons to the atmosphere, and on measures that may be taken to mitigate these emissions.

iii. Reducing GHG emissions through vessel operational changes

In addition to improving the design of the engine and vessel, GHG emissions may be reduced through operational measures. These operational measures include reduced speeds, improved routing and fleet planning, and shore-side power.

In general, the power demand of a vessel increases with at least the square of the speed; therefore, a 10 percent reduction in speed could result in more than a 20 percent reduction in fuel consumption, and therefore in GHG emissions. An increased number of vessels operating at slower speeds may be able to transport the same amount of cargo while producing less GHGs. In some cases, vessels operate at higher speeds than necessary simply due to inefficiencies in route planning or congestion at ports. Ship operators may need to speed up to correct for these inefficiencies. GHG reductions could be achieved through improved route planning, coordination between ports, and weather routing systems. GHG reductions may also be achieved by using larger vessels and through better fleet planning to minimize the time ships operate at less than full capacity.

We request comment on the extent to which greenhouse gas emissions may be practically reduced through vessel speed reductions and improved route and fleet planning.

Many ports have shore-side power available for ships as an alternative to using onboard engines at berth. To the extent that the power sources on land are able to produce energy with lower GHG emissions than the auxiliary engines on the vessel, shore-side power may be an effective strategy for GHG reduction. In addition to more traditional power generation units, shore-side power may come from renewable fuels, nuclear power, fuel cells, windmills, hydro-power, or geothermal power. We request comment on GHG reductions that could be achieved through the use of shore-side power.

c. Regulatory Options for Marine Vessels

EPA could address GHG emissions from marine vessels using strategies from a continuum of different regulatory tools, including emission standards, vessel design standards, and strategies that incorporate a broader range of operational controls. These potential regulatory strategies are briefly described below. As is the case with other source categories, EPA is also interested in exploring the potential applicability of flexible mechanisms such as banking and credit trading. With regard to ocean-going vessels, we are also exploring the potential to address GHG emissions through the International Maritime Organization under a program that could be adopted as a new Annex to the International Convention for the Prevention of Pollution from Ships (MARPOL). Those efforts are also described below. EPA requests comment on the advantages and drawbacks of each of these regulatory approaches.

As with trucks and land-based nonroad equipment, the first regulatory approach we could consider entails setting GHG emission limits for new marine diesel engines. For engines with per cylinder displacement up to 30 liters (i.e., Category 1 and Category 2), EPA has already adopted stringent emission limits for several air pollutants that may be GHGs, including NOx, methane (through hydrocarbon standards) and black carbon soot (through PM standards). This emission control program could be augmented by setting standards for GHG emissions that could be met through the application of the technologies described above (e.g., improved engine designs, hybrid power). We request comment regarding issues that EPA should consider in evaluating this approach and the most appropriate means to address the issues raised. We recognize that an engine-based regulatory structure would limit the potential GHG emission reductions compared to programs that include vessel technologies and crediting operational improvements. In the remainder of this section, we consider other options that would have the potential to provide greater GHG reductions by providing mechanisms to account for vessel and operational changes.

A second regulatory approach to address GHG emissions from marine vessels is to set equipment standards. As described above, these could take the form of standards that require reduced air and/or water resistance, improved propeller design, and auxiliary power optimization. Equipment standards could also address various equipment onboard vessels, such as refrigeration units. While Annex VI currently contains standards for ozone depleting substances, this type of control could be applied more broadly to U.S. vessels that are not subject to the Annex VI certification requirements.

A critical characteristic of marine vessels that must be taken into account when considering equipment standards is that not all marine vessels are designed alike for the same purpose. A particular hull design change that would lower GHGs for a tug boat may not be appropriate for a lobster vessel or an ocean-going vessel. These differences will have an impact on how an equipment standard would be expressed. We request comment on how to express equipment standards in terms of an enforceable limit, and on whether it is possible to set a general standard or if separate standards would be necessary for discrete vessel types/sizes. We also request comment on the critical components of a compliance program for an equipment standard, how it can be enforced, and at what point in the vessel construction process it should be applied.

In addition to the above, the spectrum of regulatory approaches we outline in section VI.C.2.c for nonroad engines and vehicles could potentially be applied to the marine sector as well, with corresponding GHG reductions. These would include: (1) setting mission-based vessel standards (such as GHG gram per ton-mile shipping standards) for at least some marine applications where this can be reliably measured and administered, (2) allowing vessel changes such as lower resistance hull designs to generate credits against marine engine-based standards, (3) granting similar credits for operational measures such as vessel speed reductions, and (4) further allowing such credits to be used in wider GHG credit exchange programs. We note too that the implementation complexities for these approaches discussed in section VI.C.2.c apply in the marine sector as well, and these complexities increase as regulatory approaches move further along the continuum away from engine-based standards.

Separate from the Annex VI negotiations for more stringent NOx and PM standards discussed above, the United States is working with the Marine Environment Protection Committee of the IMO to explore appropriate ways to reduce CO_2 emissions from ships for several years. At the most recent meeting of the Committee, in April 2008, the Member States continued their work of assessing short- and long-term GHG control strategies. A variety of options are under consideration, including all of those mentioned above. The advantage of an IMO-based program is that it could provide harmonized international standards. This is important given the global nature of vessel traffic and given that this traffic is expected to increase in the future.

4. Aircraft

In this section we discuss and seek comment on the impact of aircraft operations on GHG emissions and the potential for reductions in GHG emissions from these operations. Aircraft emissions are generated from aircraft used for public, private, and national defense purposes including air carrier commercial aircraft, air taxis, general aviation, and military aircraft. Commercial aircraft include those used for scheduled service transporting passengers, freight, or both. Air taxis fly scheduled and for-hire service carrying passengers, freight or both, but they usually are smaller aircraft than those operated by commercial air carriers. General aviation includes most other aircraft (fixed and rotary wing) used for recreational flying, business, and personal transportation (including piston-engine aircraft fueled by aviation gasoline). Military aircraft cover a wide range of airframe designs, uses, and operating missions.

As explained previously, section 231 of the CAA directs EPA to set emission standards, test procedures, and related requirements for aircraft, if EPA finds that the relevant emissions cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. In setting standards, EPA is to consult with FAA, particularly regarding whether changes in standards would significantly increase noise and adversely affect safety. CAA section 232 directs FAA to enforce EPA's aircraft engine emission standards, and 49 U.S.C. section 44714 directs FAA to regulate fuels used by aircraft. Historically, EPA has worked with FAA and the International Civil Aviation Organization (ICAO) in setting emission standards and related requirements. Under this approach international standards have first been adopted by ICAO, and subsequently EPA has initiated CAA rulemakings to establish domestic standards that are at least as stringent as ICAO's standards. In exercising EPA's own standard-setting authority under the CAA, we would expect to continue to work with FAA and ICAO on potential GHG emission standards, if we found that aircraft GHG emissions cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare.

Over the past 25-30 years, EPA has established aircraft emission standards covering certain criteria pollutants or their precursors and smoke; these standards do not currently regulate emissions of CO_2 and other GHGs.[189] However, provisions addressing test procedures for engine exhaust gas emissions state that the test is designed to measure various types of emissions, including CO_2, and to determine mass emissions through calculations for a simulated aircraft landing and takeoff cycle (LTO). Currently, CO_2

[189] Our existing standards include hydrocarbon emissions and CH_4 is a hydrocarbon. If CH_4 is present in the engine exhaust, it would be measured as part of the LTO test procedure. There is not a separate CH_4 emission standard for aircraft engines.

emission data over the LTO cycle is collected and reported.[190] Emission standards apply to engines used by essentially all commercial aircraft involved in scheduled and freight airline activity.[191]

a. GHG Emissions from Aircraft Operations

Aircraft engine emissions are composed of about 70 percent CO_2, a little less than 30 percent water vapor, and less than one percent each of NOx, CO, sulfur oxides (SOx), non-methane volatile organic carbons (NMVOC), particulate matter (PM), and other trace components including hazardous air pollutants (HAPs). Little or no nitrous oxide (N_2O) emissions occur from modern gas turbines. Methane (CH_4) may be emitted by gas turbines during idle and by relatively older technology engines, but recent data suggest that little or no CH_4 is emitted by more recently designed and manufactured engines.[192] By mass, CO_2 and water vapor are the major compounds emitted from aircraft operations that relate to climate change.

In 2006, EPA estimated that among U.S. transportation sources, aircraft emissions constituted about 12 percent of CO_2 emissions, and more broadly, about 12 percent of the combined emissions of CO_2, CH_4, and N_2O. Together CH_4 and N_2O aircraft emissions constituted only about 0.1 percent of the combined CO_2, CH_4, and N_2O emissions from U.S. transportation sources, and they make up about one percent of the total aircraft

[190] Certification information includes fuel flow rates over the different modes (and there are specified times in modes) of the LTO cycle. Utilizing this information, the ICAO Engine Emissions Databank reports kilograms of fuel used during the entire LTO cycle (see http://www.caa.co.uk/default.aspx?catid=702&pagetype=90).

[191] Regulated aircraft engines are used on commercial aircraft including small regional jets, single-aisle aircraft, twin-aisle aircraft, and 747s and larger aircraft.

[192] IPCC, Aviation and the Global Atmosphere, 1999,at http://www.grida.no/climate/ipcc/aviation/index.htm

emissions of CO_2, CH_4, and N_2O.[193] Aircraft emissions were responsible for about 4 percent of CO_2 emissions from all U.S. sources, and about 3 percent of CO_2, CH_4, and N_2O emissions collectively. While aircraft CO_2 emissions have declined by about 6 percent between 2000 and 2006, from 2006 to 2030, the U.S. Department of Energy projects that the energy use of aircraft will increase by about 60 percent (excluding military aircraft operations).[194] Commercial aircraft make up about 83 percent of both CO_2 emissions and the combined emissions of CO_2, CH_4, and N_2O for U.S. domestic aircraft operations. In addition, U.S. domestic commercial aircraft activity represents about 24 percent of worldwide commercial aircraft CO_2 emissions. With international aircraft departures, the total U.S. CO_2 emissions from commercial aircraft are about 35 percent of the total global commercial aircraft CO_2 emissions.[195,196] Globally, 93 percent of the fuel burn (a surrogate for CO_2) and 92 percent of NOx emissions from commercial aircraft occur outside of the basic LTO cycle (i.e., operations nominally above 3,000 feet).[197]

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[193] U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2006*, April 2008, USEPA #430-R-08-005, available at http://www.epa.gov/climatechange/emissions/usinventoryreport.html.

[194] Energy Information Administration, Annual Energy Outlook 2008, Report #: DOE/EIA-0383 (2008), March 2008, available at http://www.eia.doe.gov/oiaf/aeo/ . These Department of Energy projections are similar to FAA estimates (FAA, Office of Environment and Energy, Aviation and Emission: A Primer, January 2005, at pages 10 and 23, available at http://www.faa.gov/regulations_policies/policy_guidance/envir_policy/media/aeprimer.pdf). The FAA projections were based on FAA long-range activity forecasts that assume a constant rate of emissions from aircraft engines in conjunction with an increase in aviation operations. It does not take into account projected improvements in aircraft, aircraft engines, and operational efficiencies.

[195] FAA, System for Assessing Aviation's Global Emissions, Version 1.5, *Global Aviation Emissions Inventories for 2000 through 2004*, FAA-EE-2005-02, September 2005, available at http://www.faa.gov/about/office_org/headquarters_offices/aep/models/sage/ .

[196] International flights are those that depart from the U.S. and arrive in a different country.

[197] FAA, System for Assessing Aviation's Global Emissions, Version 1.5, *Global Aviation Emissions Inventories for 2000 through 2004*, FAA-EE-2005-02, September 2005, at page 10, at Table 3, available at http://www.faa.gov/about/office_org/headquarters_offices/aep/models/sage/ .

The compounds emitted from aircraft that directly relate to climate change are CO_2, CH_4, N_2O and, in highly specialized applications, SF_6.[198] Aircraft also emit other compounds that are indirectly related to climate change such as NOx, water vapor, and PM. NOx is a precursor to cruise-altitude ozone, which is a GHG. An increase in ozone also results in increased tropospheric hydroxyl radicals (OH) which reduces ambient CH_4, thus potentially at least partially offsetting the warming effect from the increase in ozone. Water vapor and PM modify or create cloud cover, which in turn can either amplify or dampen climate change.[199] Contrails are unique to aviation operations, and persistent contrails are of interest because they increase cloudiness.[200] The IPCC Fourth Assessment Report (2007) has characterized the level of scientific understanding as low to very low regarding the radiative forcing of contrails and aviation induced cirrus clouds.[201] EPA requests information on the climate change compounds emitted by aircraft and the scientific understanding of their climate effects, including contrail formation and persistence.

b. Potential for GHG Reductions from Aircraft Operations

[198] SF_6 is used as an insulating medium in the radar systems of some military reconnaissance planes. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Volume 3 Industrial Processes and Product Use, Chapter 8 Other Product Manufacture and Use, Section 8.3 Use of SF_6 and HFCs in Other Products; http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm

[199] IPCC, Climate Change 2007 - The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the IPCC, Chapter 2, Changes in Atmospheric Constituents and in Radiative Forcing.

[200] EPA, *Aircraft Contrails Factsheet*, EPA430-F-00-005, September 2000, developed in conjunction with NASA, the National Oceanic and Atmospheric Administration (NOAA), and FAA, available at http://www.epa.gov/otaq/aviation.htm .

[201] IPCC, Climate Change 2007 - The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the IPCC, Chapter 2, Changes in Atmospheric Constituents and in Radiative Forcing, (page 202).

There are both technological controls and operational measures potentially available to reduce GHG emissions from aircraft and aircraft operations. These are discussed below.

i. Reducing GHG emissions through aircraft engine changes

Fuel efficiency and therefore GHG emission rates are closely linked to jet aircraft engine type (e.g., high bypass ratio) and choice of engine thermodynamic cycles (e.g., pressure and temperature ratios), but modifications in the design of the engine's combustion system can also have a substantial effect on the composition of the exhaust.[202] Turbofan engines, with their high bypass ratios and increased temperatures, introduced in the 1970s and 1980s reduced CO_2, HC, and CO emissions, but in many cases put upward pressure on NOx emission rates. Also, a moderate increase in the engine bypass ratio (high bypass turbofan) decreases fuel burn (and CO_2) by enhancing propulsive efficiency and reduces noise by decreasing exhaust velocity, but it may lead to increased engine pressure ratio and potentially higher NOx.[203] There is no single relationship between NOx and CO_2 that holds for all engine types. As the temperatures and pressures in the combustors are increased to obtain better efficiency, emissions of NOx increase, unless there is also a change in combustor technology.[204] There are

[202] IPCC, Aviation and the Global Atmosphere, 1999, at Aircraft Technology and Its Relation to Emissions, at page 221, at section 7.1, available at http://www.grida.no/climate/ipcc/aviation/index.htm
[203] ICCIA, *Technical Design Interrelationships*, Presentation by Dan Allyn, ICCAIA Chair, at Aviation and the Environment Conference, March 19, 2008, available at http://www.airlines.org/government/environment/Aviation+and+the+Environment+Conference+Presentations.htm .
[204] IPCC, Aviation and the Global Atmosphere, 1999, at Aircraft Technology and Its Relation to Emissions, at page 237, at section 7.5.6, available at http://www.grida.no/climate/ipcc/aviation/index.htm .

interrelationships among the different emissions and noise to be considered in engine design.

The three major jet engine manufacturers in the world are General Electric (GE), Pratt and Whitney, and Rolls-Royce. All of these manufacturers supply engines to both U.S. and non-U.S. aircraft manufacturers, and their engines are installed on aircraft that operate worldwide. These three manufacturers are now (or will be in the future) producing more fuel efficient (lower GHG) engines with improved NOx. The General Electric GEnx jet engine is being developed for the new Boeing 787, and GE's goal is to have the GEnx engine meet NOx levels 50 percent lower than the ICAO standards approved in 2005.[205] The combustor technology GE is employing is called the Twin Annular, Pre-mixing Swirler (TAPS) combustor. In addition, the GEnx is expected to improve specific fuel consumption by 15 percent compared to the previous generation of engine technology (GE's CF6 engine).[206]

Pratt and Whitney has developed the geared turbofan technology that is expected to deliver 12 percent reduction in fuel burn while emitting half of the NOx emissions compared to today's engines. In addition to an advanced gear system, the new engine design includes the next generation technology for advanced low NOx (TALON). The rich-quench-lean TALON combustor utilizes advanced fuel/air atomizers and mixers, metallic liners, and advanced cooling management to decrease NOx emissions during the LTO and high-altitude cruise operations. Flight testing of the engine is expected this

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[205] The NOx standards adopted at the sixth meeting of ICAO's Committee on Aviation Environmental Protection (CAEP) in February 2004 were approved by ICAO in 2005.

[206] General Electric, Press Release, *Driving GE Ecomagination with the Low-Emission GEnx Jet Engine*, July 20, 2005, available at http://www.geae.com/aboutgeae/presscenter/genx/genx_20050720.html .

year, and introduction into service is expected in 2012.[207] Mitsubishi Heavy Industries has chosen the engine for its regional jet.[208,209]

Rolls-Royce's Trent 1000 jet engine will power the Boeing 787s on order for Virgin Atlantic airlines. The Trent 1000 powered 787 is expected to improve fuel consumption by up to 15 percent compared to the previous generation of engines (Rolls-Royce's Trent 800 engine).[210] The technology in the Trent 1000 improves the operability of the compressors, and enables the engine to run more efficiently at lower speeds. This contributes to better fuel burn, especially in descent.[211]

ii. Reducing GHG emissions through aircraft changes

Aircraft (or airframe) efficiency gains are mainly achieved through aerodynamic drag and weight reduction.[212] Most of the fuel used by aircraft is needed to overcome aerodynamic drag, since they fly at very high speeds. Reduction of aerodynamic drag can substantially improve the fuel efficiency of aircraft thus reducing GHG emissions.

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[207] Engine Yearbook, *Pratt & Whitney changing the game with geared turbofan engine*, 2008, at page 96.
[208] Aviation, *Japanese Airliner to Introduce PW's New Engine Technology*, by Chris Kjelgaard, October 9, 2007, available at http://www.aviation.com/technology/071009-pw-geared-turbofan-powering-mrj.html .
[209] The New York Times, *A Cleaner, Leaner Jet Age Has Arrived*, by Matthew L. Wald, April 9, 2008, available at http://www.nytimes.com/2008/04/09/technology/techspecial/09jets.html?_r=1&ex=1208491200&en=6307ad7d1372acdf&ei=5070&emc=eta1&oref=slogin .
[210] Rolls-Royce, *Trent and the environment*, available at www.rolls-royce.com/community/downloads/trent_env.pdf and the Rolls-Royce environmental report, *Powering a better world: Rolls-Royce and the environment*, 2007, available at http://www.rolls-royce.com/community/environment/default.jsp
[211] Green Car Congress, *Rolls-Royce Wins $2.6B Trent 1000 Order from Virgin Atlantic; The Two Launch Joint Environmental Initiative*, March 3, 2008, available at http://www.greencarcongress.com/2008/03/rolls-royce-win.html .
[212] U.S. Department of Transportation, *Best Practices Guidebook for Greenhouse Gas Reductions in Freight Transportation - Final Report*, Prepared for U.S. Department of Transportation via Center for Transportation and the Environment, Prepared by H. Christopher Frey and Po-Yao Kuo, Department of Civil, Construction, and Environmental Engineering, North Carolina State University, October 4, 2007, available at http://www4.ncsu.edu/~frey/Frey_Kuo_071004.pdf .

Aerodynamic drag can be decreased by installing add-on devices, such as film surface grooves, hybrid laminar flow technology, blended winglets, and spiroid tips, and GHG emissions can be reduced by each of these measures from 1.6 to 6 percent. Further discussion of these devices is provided below.

- Film surface grooves: This technology is undergoing testing, and it is an adhesive-backed film with micro-grooves placed on the outer surfaces of the wings and the fuselage of the aircraft. Film surface grooves are estimated to reduce total aerodynamic drag and GHG emissions by up to 1.6 percent.
- Hybrid laminar flow technology: Contamination on the airframe surface, such as the accumulation of ice, insects or other debris, degrades laminar flow. A newly developed concept, hybrid laminar flow technology (replace turbulent air flow), integrates approaches to maintain laminar flow. This technology can reduce fuel use by 6 to 10 percent and potentially GHG emissions by 6 percent.
- Blended winglets: A blended winglet is a commercially available wing-tip device that can decrease lift-induced drag. This technology is an extension mounted at the tip of a wing. The potential decreases in both GHG emissions and fuel use are estimated to be 2 percent.
- Spiroid tip: A spiroid tip has been pilot tested and, similar to blended winglets, it is intended to reduce lift-induced drag. This technology is a spiral loop formed by joining vertical and horizontal winglets. Greenhouse gas emissions and fuel use are both potentially estimated to be decreased by 1.7 percent.

Reductions in the weight of an aircraft by utilizing light-weight materials and weight reduction of non-essential components could lead to substantial decreases in fuel use. The weight of an airframe is about 50 percent of an aircraft's gross weight. The use of advanced lighter and stronger materials in the structural components of the airframe, such as aluminum alloy, titanium alloy, and composite materials for non-load-bearing structures, can decrease airframe weight. These materials can reduce structural weight by 4 percent. The potential reduction in greenhouse gas emissions and fuel use are estimated to both be 2 percent.

iii. Reducing GHG emissions through operational changes

Rising jet fuel prices tend to drive the aviation industry to implement practices to decrease fuel usage and lower fuel usage reduces GHG emissions.[213] Indeed this has occurred in the recent past where several airlines have reduced flights and announced plans to retire older aircraft. However, such practices are voluntary, and there is no assurance that such practices would continue or not be reversed in the future. Technology developments for lighter and more aerodynamic aircraft and more efficient engines which reduce aircraft fuel consumption and thus GHG emissions are expected to improve in the future. However, technology changes take time to find their way into the fleet. Aircraft and aircraft engines operate for about 25 to 30 years.

Air traffic management and operational changes are governed by FAA. The FAA, in collaboration with other agencies, is in the process of developing the next

[213] According to the Energy Information Administration, jet fuel prices increased by about 140 percent from 2000 to 2007 (see http://tonto.eia.doe.gov/dnav/pet/hist/rjetnyhA.htm .)

generation air transportation system (NextGen), a key environmental goal of which is to decrease aviation's contribution to GHG emissions by reducing aviation system-induced congestion and delay and accelerating air traffic management improvements and efficiencies. As will be discussed below, measures of this type implemented together with technology changes may be a way to reduce GHG emissions in the near term. A few examples of the advanced systems/procedures and operational measures are provided below.

Reduced Vertical Separation Minimum (RSVM) allows air traffic controllers and pilots to reduce the standard required vertical separation from 2,000 feet to 1,000 feet for aircraft flying at altitudes between 29,000 and 41,000 feet. This increases the number of flight altitudes at which aircraft maximize fuel and time efficiency. RSVM has led to about a 2 percent decrease in fuel burn.[214] Continuous Descent Approach is a procedure that enables continuous descent of the aircraft on a constant slope toward landing, as opposed to a staggered or staged approach, thus allowing for a more efficient speed requiring less fuel and reducing GHG emissions. Aircraft auxiliary power units (APUs) are engine-driven generators that supply electricity and pre-conditioned cabin air for use aboard the aircraft while at the gate. Ground-based electricity sources or electrified gates combined with preconditioned air supplies can reduce APU fuel use and thus CO_2 emissions substantially. Single-engine taxiing, a practice already used by some airlines, could be utilized more broadly to reduce CO_2 emissions.[215] Fuel consumption, and thus GHG emissions, could be reduced by decreasing the aircraft weight by reducing the

[214] PARTNER, Assessment of the impact of reduced vertical separation on aircraft-related fuel burn and emissions for the domestic United States, PARTNER-COE-2007-002, November 2007, available at web.mit.edu/aeroastro/partner/reports/rsvm-caep8.pdf .
[215] ICAO, *Operational Opportunities to Minimize Fuel Use and Reduce Emissions*, Circular 303 AN/176, February 2004, available at http://www.icao.int/icao/en/m_publications.html .

amount of excess fuel carried. More efficient routes and aircraft speeds would be directly beneficial to reducing full flight GHG emissions. Operational safety must be considered in the application of all of these measures.

In regard to the above three sections, we request information on potentially available technological controls (technologies for airframes, main engines, and auxiliary power units) and operational measures to reduce GHG emissions from aircraft operations. Since FAA currently administers and implements air traffic management and operational procedures, EPA would share information on these items with FAA.

Efforts are underway to potentially develop alternative fuels for aircraft in the future. Industry (manufacturers, operators and airports) and FAA established the Commercial Aviation Alternative Fuels Initiative (CAAFI) in 2006 to explore the potential use of alternative fuels for aircraft for energy security and possible environmental improvements. CAAFI's goals are to have available for certification in 2008 a 50 percent Fischer-Tropsch synthetic kerosene fuel, 2010 for 100 percent synthetic fuel, and as early as 2013 for other biofuels. However, any alternative fuel would need to be compatible with current jet fuel for commercial aircraft to prevent the need for tank and system flushing on re-fueling and to meet comprehensive performance and safety specifications. In February 2008, Boeing, General Electric, and Virgin Atlantic airlines tested a Boeing 747 that was partly powered by a biofuel made from babassu nuts and coconut oil, a first for a commercial aircraft.

EPA requests information on decreasing aircraft emissions related to climate change through the use of alternative fuels, including what is feasible in the near-term and long-term and information regarding safety, distribution and storage of fuels at airports, life-cycle impacts, and cost information. Given the Agency's work to develop a lifecycle methodology for fuels as required by the Energy Independence and Security Act, EPA also is interested in information on the lifecycle impacts of alternative fuels.

c. Options to Address GHG Emissions from the Aviation Sector

In the preceding nonroad sections, we have described a continuum of regulatory approaches that take us from traditional engine standards through a range of potential approaches for vehicle standards and even potential mechanisms to credit operational changes. For commercial aircraft, although the reasons to consider such continuum are just as valid, the means to accomplish these could be simpler. We see at least two potential basic approaches for regulating aircraft GHG emissions under the CAA, engine emission standards or a fleet average standard. These approaches are discussed further below.

The first approach we can consider is setting emission standards as an extension of our current program. Under this approach we would establish, for example, CO_2 exhaust emission standards and related requirements for all newly and previously certified engines applicable in some future year and later years. These standards could potentially cover all phases of flight. Depending on timing, this first set of standards could effectively be used to either establish baseline values and/or to require reductions.

As described earlier, ICAO and EPA currently require measurement and reporting of CO_2 emissions during engine exhaust gaseous emissions testing for the current certification cycle (although the current absence of this information for other

GHGs does not rule out a similar approach for those GHGs).[216] Although test procedures for measuring CO_2 are in place already and LTO cycle CO_2 data exists, test requirements to simulate full-flight emissions are a significant consideration. Further work is needed to determine how CO_2 and other GHG emissions measured over the various modes of LTO cycle might be used to as a means to estimate or simulate cruise or full-flight emissions. A method has been developed by ICAO for determining NOx for climb/cruise operations (outside the LTO) based on LTO data, and this could be a good starting point.[217,218] For CO_2, and potentially NOx and other GHGs as well, the climb/cruise methods could then be codified as test procedures**,** and we could then establish emission standards for these GHGs. We request comments on the need to develop a new test procedure for aircraft engines and the best approach to developing such a procedure, including the viability and need for altitude simulation tests for emissions certification.

Furthermore, to drive the development of engine technology, we could pursue near- and long-term GHG exhaust emission standards. Near-term standards, which could for example apply 5 years from their promulgation, would encourage engine manufacturers to use the best currently available technology. Long-term standards could require more significant reductions in emissions beyond the near-term values. In both cases, new standards could potentially apply to both newly and previously certified engines, but possibly at different levels and implementation dates based on lead time considerations. Under this approach, we would expect that no engines would be able to

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[216] EPA's regulations at 40 C.F.R. 87.62 require testing at each of the following operating modes in order to determine mass emission rates: taxi/idle, takeoff, climbout, descent and approach.

[217] ICAO, CAEP/7 Report, Working Paper 68, CAEP/7-WP/68, February 2007, see http://www.icao.int .

[218] ICAO has deferred work on using the NOx climb/cruise method for a certification procedure and standards since future engines (potential new technologies) may behave in a different way. There may need to be future work to consider the aircraft mission, taking into account all phases of flight and the performance of the whole aircraft.

be produced indefinitely if they did not meet the new standards, except possibly based on the inclusion of an emissions averaging program for GHG as discussed below.

For emission standards applied to other mobile sources, EPA has often incorporated emission averaging, banking and trading (ABT) programs to provide manufacturers more flexibility in phasing-in and phasing-out engine models as they seek to comply with emission standards. In these types of programs, the average emissions within a manufacturer's current year product line are required to meet the applicable standard, which allows a manufacturer to produce some engines with emission levels above the standard provided they are offset with some below the standard. The calculation for average compliance is usually sales, activity, and power weighted. In addition, emissions credits and debits may be generated, banked and traded with other engine manufacturers. We request comment on the approaches to engine standards for reducing GHG emissions and an engine ABT program for new GHG emission standards, including whether certain GHGs, such as CO_2, are more amenable than are other GHGs to being addressed by such a program.

As part of this option, we could pursue new standards and test procedures for PM that would encompass LTO and climb/cruise operations (ICAO and EPA currently do not have test procedures or emission standards for PM from aircraft), if we find that aircraft PM emissions cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare.[219] Work has been underway for several years under the auspices of the Society of Automotive Engineers E-31 Committee, and EPA/FAA are working actively with this committee to bring forth a draft recommended test procedure.

[219] As mentioned earlier, PM modifies or creates cloud cover, which in turn can either amplify or dampen climate change. Aircraft are also a source of PM emissions that contribute to local air quality near the ground, and the public health and welfare effects from these emissions are an important consideration.

In addition, requirements could potentially be proposed and adopted using the same approach as discussed above for GHGs for near- and long-term standards and newly and already certified engines.

In the preceding nonroad sections, we have discussed several approaches or variations on approaches to include vehicle and operational controls within a GHG emission control program for nonroad equipment. In doing so, we have not discussed direct regulation of equipment or fleet operators. Instead, we have focused on approaches that would credit fleet operators for improvements in operational controls within a vehicle or engine GHG standards program. Those approaches described in section VI.C.2 could apply to aircraft GHG emissions as well, and we request comments on the potential to apply those approaches to aircraft.

As a second approach, in the case of aircraft, it may be more practical and flexible to directly regulate airline fleet average GHG emissions. Under such an approach we would set a declining fleet average GHG emission standard for each airline, based on the GHG emission characteristics of its entire fleet. This would require GHG certification emission information for all engines in the fleet from the aircraft engine manufacturers and information on hours flown and average power (e.g., thrust). Airlines would have GHG emission baselines for a given year based on the engine emission characteristics of their fleet, and beginning in a subsequent year, airlines would be required to reduce their emissions at some annual rate, at some rolling average rate, or perhaps to some prescribed lower level in a future year. This could be done as a fleet average GHG emission standard for each airline or through a surrogate measure of GHGs such as airline total fuel consumption, perhaps adjusted for flight activity in some way. This could cover all domestic operations and international departures of domestic airlines. The fleet average program could potentially be implemented in the near term since it is not as reliant on lead times for technology change.

Although we might develop such a declining fleet average emissions program based on engine emissions, an operational declining fleet average program could potentially be designed to consider the whole range of engine, aircraft and operational GHG control opportunities discussed above. Under this approach compliance with a declining fleet average standard would be based not only on parameters such as engine emission rates and activity, but could also consider efficiencies gained by use of improved operational controls. It is important to note that as part of this approach, a recordkeeping and reporting system would need to be established for airlines to measure and track their annual GHG emissions. Perhaps this could be accomplished through a surrogate measure of GHGs such as airline total fuel consumption. Today each airline reports its annual fuel consumption to the Department of Transportation. We request comment on the operational fleet average GHG emission standard concept, how it could be designed and implemented, what are important program design considerations, and what are potential metrics for establishing standards and determining compliance. While we have discussed two basic concepts above, we invite comment and information on any other approaches for regulating aircraft GHG emissions.

d. Other Considerations

We are aware that the European Commission (EC) has proposed a program to cap aviation-related CO_2 emissions (cap is 100% of sector's emissions during 2004-2006). They would by 2012 include CO_2 emissions from all flights arriving at and departing from European airports, including U.S.-certified aircraft, in the European Union Emissions Trading Scheme (ETS).[220,221] If the proposal is adopted, airlines from all countries (EU and non-EU) will be required to submit allowances to cover emissions from all such aircraft flights over the compliance period (e.g., 5 years). The EU has expressed some interest in developing a program to waive this requirement for foreign-flagged carriers (non-EU carriers) whose nations develop "equivalent" measures. The petitioners discussed this program, and we invite comments on it.

The 36th Session of ICAO's Assembly met in September 2007 to focus on aviation emissions related to climate change, including the use of emissions trading.[222] In response to the EC's proposed aviation program, the Assembly agreed to establish a high-level group through ICAO to develop a framework of action that nations could use to address these emissions. A report with recommendations is due to be completed before the next Assembly Session in 2010. In addition, the Assembly urged all countries

[220] *Commission Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community*, 2006/0304 (COD), COM(2006) 818 final, December 20, 2006, available at http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&1g=en&type_doc=COMfinal&an_doc=2006&nu_doc=818 .

[221] Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community - Political agreement, December 21, 2007 available at http://register.consilium.europa.eu/pdf/en/07/st16/st16855.en07.pdf.

[222] ICAO, Assembly – 36th Session, Report of the Executive Committee on Agenda Item 17, A36-WP/355, September 27, 2007.

to not apply an emissions trading system to other nations' air carriers except on the basis of mutual consent between those nations.[223]

To address greenhouse gas emissions, ICAO's focus currently appears to be on the continued development of guidance for market-based measures.[224] These measures include emissions trading (for CO_2), environmental levies, and voluntary measures. Emissions trading is when an overall target or cap is established and a market for carbon is set. This approach allows participants to buy and sell allowances, the price of which is established by the market. Environmental levies include taxes and charges with the objective of generating an economic incentive to decrease emissions. Voluntary measures are unilateral actions by industry or in an agreement between industry and government to decrease emissions beyond the base case. Note, for ICAO's efforts on CO_2 emission charges, it evaluated an aircraft efficiency parameter, and in early 2004 ICAO decided that there was not enough information available at the time to create a parameter that correlated properly with aircraft/engine performance.[225] However, it is important to note, that unlike EPA, ICAO has not been petitioned under applicable law to determine whether GHG emissions from aircraft may reasonably be anticipated to endanger public health or welfare or to take any action if such a finding is made. We invite information on reducing overall emissions that relate to climate change from aircraft through a cap-and-trade system or other market-based system.

[223] ICAO, Assembly – 36th Session, Report of the Executive Committee on Agenda Item 17, A36-WP/355, September 27, 2007.
[224] ICAO, ICAO Environmental Report 2007, available at http://www.icao.int/env/ .
[225] ICAO, CAEP/6 Report, February 2004, available at http:/www.icao.int.

Another consideration in the GHG program is the regulation of emissions from engines commonly used in general aviation aircraft. As indicated earlier, our current aircraft engine requirements apply to gas turbine engines that are mainly used by commercial aircraft, except in cases where general aviation aircraft sometimes use commercial engines. Our requirements do not currently apply to many engines used in business jets or to piston-engines used in aircraft that fall under the general aviation category, although our authority under the Clean Air Act extends to any aircraft emissions for which we make the prerequisite finding that those emissions cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare.[226] In 2006, general aviation made up about one percent of the CO_2 emissions from U.S. domestic transportation sources, and about 8 percent of CO_2 emissions from U.S. domestic aircraft operations.[227] Regulating GHG emissions from this sector of aviation would require the development of test procedures and emission standards. EPA requests comment on this matter and on any elements we should consider in potentially establishing test procedures and emission standards for these currently unregulated engines.

5. Nonroad Sector Summary

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[226] As specified in 40 C.F.R. 87.10, our emission standards apply to different classes of aircraft gas turbine engines, which have a particular minimum rated output. The engine class and rated output specifications correspond to certain engine operational or use practices, but we do not, by the terms of the rule, exempt general aviation aircraft or engines as such.

[227] U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2006*, April 2008, USEPA #430-R-08-005, available at http://www.epa.gov/climatechange/emissions/usinventoryreport.html .

There are a number of potential approaches for reducing GHG emissions from the nonroad sector within the regulatory structure of the CAA. In considering our next steps to address GHG emissions from this sector, we seek comment on all of the issues raised in this notice along with recommendations on the most appropriate means to address the issues.

D. Fuels

1. Recent Actions which Reduce GHG Impacts of Transportation Fuels

Historically under Title II of the CAA, EPA has treated vehicles, engines and fuels as a system. The interactions between the designs of vehicles and the fuels they use must be considered to assure optimum emission performance at minimum cost. While EPA continues to view its treatment of vehicles, engines and fuels as a system as appropriate, we request comment on whether it would continue to be advantageous to take this approach for the purpose of controlling GHG emissions from the transportation sector. This section describes existing authorities under the CAA for regulating the GHG emissions contribution of fuels. In this discussion, we ask for comment on the combination of authorities that would suit the goal of GHG emission reductions from transportation fuel use.

In response to CAA section 211(o) adopted as part of the Energy Policy Act of 2005 (Energy Act of 2005), EPA issued regulations implementing a Renewable Fuels Standard (RFS) program (72 FR 23900, May 1, 2007). These regulations were designed to ensure that 4.0 billion gallons of renewable fuel were used in motor vehicles beginning in 2006, gradually increasing to 7.5 billion gallons in 2012. While the primary purpose of this provision of the Energy Act of 2005 was to reduce U.S. dependence on petroleum-based fuel and promote domestic sources of energy, EPA analyzed the extent to which reductions in GHG emissions would also result from the new RFS program. Therefore, for the first time in a major rule, EPA presented estimates of the GHG impacts of replacing petroleum-based transportation fuel with fuel made from renewable feedstocks.

In December 2007, EISA revised section 211(o) to set three specific volume standards for biomass-based diesel, cellulosic biofuel, and advanced biofuel as well as a total renewable fuel standard of 36 billion gallons annually by 2022. Certain eligible fuels must also meet specific GHG performance thresholds based upon a lifecycle GHG assessment. In addition to being limited to renewable fuels, EISA puts constraints on what land sources can be used to produce the renewable fuel feedstock, requires assessment of both primary and significant secondary land use impacts as part of the required lifecycle GHG emissions assessment, and has a number of other specific provisions that affect both the design of the rule and the required analyses. EISA requires that EPA adopt rules implementing these provisions by January 2009.

The U.S. federal government is not alone in considering or pursuing fuel changes which can result in reductions of GHG emissions from the transportation sector California is moving toward adopting a low carbon fuel standard that it anticipates will result in significant reductions in GHG emissions through such actions as increasing the use of renewable fuel and requiring refiners to offset any emission increases that might result from changes in crude oil supply. Canada, the countries of the European Union, and a number of other nations are considering or in the process of requiring fuel changes as part of their strategy to reduce GHG emissions from the transportation sector.

2. GHG Reductions under CAA Section 211(o)

The two principal CAA authorities available to EPA to regulate fuels are sections 211(c) and 211(o). As explained in previously, section 211(o), added by the Energy Act of 2005 and amended by EISA, requires refiners and other obligated parties to assure that the mandated volumes of renewable fuel are used in the transportation sector. Section 211(o) only addresses renewable fuels; other alternative fuels such as natural gas are not included nor are any requirements imposed on the petroleum-based portion of our transportation fuel pool. EPA is authorized to waive or reduce required renewable fuel volumes specified in EISA under certain circumstances, and is also authorized to establish required renewable fuel volumes after the years for which volumes are specified in the Act (2012 for biomass-based diesel and 2022 for total renewable fuel, cellulosic biofuel and advanced biofuel). One of the factors EPA is to consider in setting standards is the impact of production and use of renewable fuels on climate change. In sum, EPA has limited discretion under 211(o) to improve GHG performance of fuels.

Changes in fuel feedstock sources (for example, petroleum versus biomass) and processing technologies can have a significant impact on GHG emissions when assessed on a lifecycle basis. As analyzed in support of the RFS rules, a lifecycle approach considers the GHG emissions associated with producing a fuel and bringing it to market and then attributes those emissions to the use of that fuel. In the case of petroleum, the lifecycle would account for emissions resulting from extraction of crude oil, shipping the oil to a refiner, refining the oil into a fuel, distributing the fuel to retail markets and finally the burning the gasoline or diesel fuel in an engine. This assessment is sometimes referred to as a "well-to-wheels" assessment. A comparable assessment for renewable fuel would include the process of growing a feedstock such as corn, harvesting the feedstock, transferring it to a fuel production facility, turning the feedstock into a fuel, getting the renewable fuel to market and then assessing its impact on vehicle emissions. EPA presented estimates of GHG impacts as part of the assessment for the Energy Act of 2005 RFS rulemaking that increasing renewable fuel use from approximately 4 billion gallons to 7.5 billion gallons by 2012. However, as noted below, the methodology used in that RFS rulemaking did not consider a number of relevant issues.

The 7.5 billion gallons of renewable fuel required by the Energy Act of 2005 program represents a relatively small portion of the total transportation fuel pool projected to be used in 2012 (add figure as % of energy). The much larger 36 billion gallons of renewable fuel required by EISA for 2022 would be expected to displace a much larger portion of the petroleum-based fuel used in transportation and would similarly be expected to have a greater impact on GHG emissions. Comments on the RFS proposal suggested improvements to the lifecycle assessment used in that rule. For instance, the RFS analysis did not fully consider the impact of land use changes both domestically and abroad that would likely result from increased demand for corn and soybeans as feedstock for ethanol and biodiesel production in the U.S. EPA largely agreed with these comments but was not able to incorporate a more thorough assessment of land use impacts and other enhancements in its lifecycle emissions modeling in time.

We are undertaking such a lifecycle assessment as we develop the proposal to implement EISA fuel mandates. Because this updated lifecycle assessment will incorporate more factors and the latest data, it will undoubtedly change the estimates of GHG reductions included in the Energy Act 2005 RFS package.

EISA recognizes the importance of distinguishing between renewable fuels on the basis of their impact on lifecycle GHG emissions. Nevertheless, EISA stops short of directly comparing and crediting each fuel on the basis of its estimated impact on GHG emissions. For example, while requiring a minimum of 60% GHG emission reduction for cellulosic biomass fuel compared to the petroleum-based fuel displaced, EISA does not distinguish among the multiple pathways for producing cellulosic biofuel even though these pathways might differ significantly in their lifecycle GHG emission performance. It may be that the least costly fuels meeting the cellulosic biofuel GHG performance threshold will be produced which may not be the fuels with the greatest GHG benefit or even the greatest GHG benefit when considering cost (e.g., GHG reduction per dollar cost). The same consideration applies to other fuels and pathways. Without further delineating fuels on the basis of their lifecycle GHG impact, no incentive is provided for production of particular fuels which would minimize lifecycle GHG emissions within the EISA fuel categories.

We request comment on the importance of distinguishing fuels beyond the categories established in EISA and how an alternative program might further encourage the development and use of low GHG fuels. We also request comment on the ability (including considerations of uncertainty and the measurement of both direct and indirect emissions associated with the production of fuels) of lifecycle analysis to estimate the

GHG emissions of a particular fuel produced and used for transportation and how EPA should delineate fuels (e.g., on the basis of feedstock, production technology, etc.). EPA notes that a certain level of aggregation in the delineation of fuels may be necessary, but that the greater the aggregation in the categories of fuels, the fewer incentives exist for changes in behavior that would result in reductions of GHG emissions. EPA asks for comment on this idea as well as how and whether methods for estimating lifecycle values for use in a regulatory program can take into account the dynamic nature of the market. EPA also requests comment on the relative efficacy of a lifecycle-based regulatory approach versus a price-based (e.g., carbon tax or cap and trade) approach to incentivize the multitude of actors whose decisions collectively determine the GHG emissions associated with the production, distribution and use of transportation fuels. Finally, we request comment on the ability to determine lifecycle GHG performance for fuels and fuel feedstocks that are produced outside the U.S.

EISA addresses impacts of renewable fuels other than GHG impacts. Section 203 of EISA directs that the National Academy of Sciences be asked to consider the impacts on producers of feed grains, livestock, and food and food products, energy producers, individuals and entities interested in issues relating to conservation, the environment and nutrition, users and consumers of renewable fuels, and others potentially impacted. Section 204 directs EPA to lead a study on environmental issues, including air and water quality, resource conservation and the growth and use of cultivated invasive or noxious plants. We request comment on what impacts other than GHG impacts should be considered as part of a potential fuels GHG regulation and how such other impacts should be reflected in any policy decisions associated with the rule. These impacts could include the potential impacts on food prices and supplies.

Programs under section 211(o) are subject to further limitations. Limited to renewable fuels, these programs do not consider other alternative fuels such as coal-to-liquids fuel that could be part of the transportation fuel pool and could impact the lifecycle GHG performance of the fuel pool. Additionally, EISA's GHG performance requirements are focused on the renewable fuels, not the petroleum-based fuel being replaced. Under EISA, the GHG performance of renewable fuels is tied to a 2005 baseline for petroleum fuel. No provision is included for considering how the GHG impacts of the petroleum-based fuel pool might change over time, either for the purpose of determining the comparative performance for threshold compliance of renewable fuels or for assessing the impact of the petroleum fuel itself on transportation fuel GHG emissions. Thus, for example, there is no opportunity under EISA to recognize and credit improvements in refinery operation which might improve the lifecycle GHG performance of the petroleum-based portion of the transportation fuel pool. Comments are requested on the importance of lowering GHG emissions from transportation fuels via the inclusion of alternative, non-renewable fuels in a GHG regulatory program as well as the petroleum portion of the fuel pool, thus providing opportunity to reflect improvements in refinery practices.

Finally while the current RFS and anticipated EISA programs will tend to improve the GHG performance of the transportation fuel pool compared to a business as usual case, they would not in any way cap the GHG emissions due to the use of fuels. In fact, under both programs, the total amount of fuel consumed and thus the total amount of

GHG emissions from those fuels can both increase. We note that other lifecycle fuel standard programs being developed such as those in California, Canada, and Europe, while also taking into account the GHG emissions reduction potential from petroleum fuels, do not cap the emissions from the total fuel pool; the GHG per gallon of transportation fuel consumed may decrease but the total gallons consumed are not constrained such that the total GHG emissions from fuel may continue to grow. We request comment on setting a GHG control program covering all transportation fuels used in the United States which would also cap the total emissions from these transportation fuels.

Elsewhere in this notice, comments are solicited on the potential for regulating GHG emissions from stationary sources which could include petroleum refineries and renewable and alternative fuel production facilities. EPA recognizes the potential for overlapping incentives to control emissions at fuel production facilities. We request comment on the implications of using a lifecycle approach in the regulation of GHG emissions from fuels which would include refinery and other fuel production facilities while potentially also directly regulating such stationary source emission under an additional control program. Recognizing that the use of biomass could also ba a control option for stationary sources seeking to reduce their lifecycle GHG impacts, EPA requests comment on the implications of using biomass for transportation fuel in potential competition as an energy source in stationary source applications.

3. Option for Considering GHG Fuel Regulation under CAA Section 211(c)

Section 211(c)(1) of the CAA has historically been the primary authority used by EPA to regulate fuels. It provides EPA with authority to “control or prohibit the manufacture, introduction into commerce, offering for sale, or sale of any fuel or fuel additive for use in a motor vehicle, motor vehicle engine, or nonroad engine of nonroad vehicle [(A)] if in the judgment of the Administrator any emission product of such fuel or fuel additive causes or contributes to air pollution or water pollution (including any degradation in the quality of groundwater) which may reasonably be anticipated to endanger public health or welfare.” Section 211(c)(2) specifies that EPA must consider all available relevant medical and scientific information, including consideration of other technologically or economically feasible means of achieving vehicle emission standards under CAA section 202 before controlling a fuel under section 211(c)(1)(A). A prerequisite to action under 211(c)(1) is an EPA finding that a fuel or fuel additive, or emission product of a fuel or fuel additive, causes or contributes to air or water pollution that may reasonably be anticipated to endanger public health or welfare. Issues related to an endangerment finding are discussed in section V of this advance notice.

EPA asks for comment on whether section 211(c) could be read as providing EPA a broader scope of authority to establish a new GHG fuel program than section 211(o). Specifically, EPA asks for comment on whether section 211(c)(1)(A) could allow EPA to start the program as soon as appropriate in light of our analysis and similarly cover the time period most appropriate; whether it could allow a program that would encourage the use of both renewable and alternative fuels with beneficial GHG emissions impacts and discourage those fuels with relatively detrimental GHG impacts; and whether it could allow EPA to establish requirements for all fuels (gasoline, diesel, renewables, alternative and synthetic fuel, etc.) used in both highway and nonroad vehicles and engines. EPA requests comment on whether the flexibilities under section 211(c) allow it to consider a broad set of options for controlling GHG emissions through fuels, including those that solely regulate the final point of emissions such as tailpipe emissions rather than also controlling the emissions at the fuel production facility through a lifecycle approach.

Typically EPA has acted through CAA section 211(c) to prohibit the use of certain additives (e.g., lead) in fuel, to control the level of a component of fuel to reduce harmful vehicle emissions (e.g., sulfur, benzene), or to place a limit on tailpipe emissions of a pollutant (e.g., the reformulated gasoline standards for volatile organic compounds and toxics emissions performance). While multiple approaches may be available to regulate GHG emissions under section 211(c), one option could require refiners and importers of gasoline and diesel meet a GHG performance standard based on reducing their lifecycle GHG emissions of the fuel they import or produce. They would comply with this performance standard by ensuring the use of alternative and/or renewable fuels that have lower lifecycle GHG emissions than the gasoline and diesel they displace and through selection of lower petroleum sources that also reduce the lifecycle GHG performance of petroleum-based fuel. EPA asks comment on whether section 211(c) could authorize such an approach because it would be a control on the sale or manufacture of a fuel that addresses the emissions of GHGs from the transportation fuels that would be the subject the endangerment finding discussed in section V. Comments are requested on this interpretation of 211(c) authority.

As pointed out above, neither the Energy Act of 2005 RFS program nor the forthcoming program under EISA directly addresses the varying GHG emission reduction potential of each fuel type and production pathway. EPA asks comment on whether it could have the authority under CAA section 211(c) to design and implement a program that includes not only renewable fuels but other alternative fuels, considers the GHG emissions from the petroleum portion of the fuel pool and reflects differences in fuel production not captured by the GHG thresholds established under EISA, including differences in technology at the fuel production facility. We request comment on the factors EPA should consider in developing a GHG fuel control program under section 211(c) and how including such factors could serve to encourage the use of low GHG-emitting practices and technology.

We note that the RFS and the forthcoming EISA programs require refiners and other obligated parties to meet specified volume standards and that these programs are anticipated to continue. We request comment on the impacts and opportunities of implementing both a GHG program under 211(c) and volume mandates under 211(o).

EPA seeks comment on the potential for reducing GHG emissions from transportation fuel over and above those reductions that could be achieved by RFS and the anticipated EISA requirements. Although EPA has not completed its analysis of the GHG emission reductions expected under the combined RFS and EISA programs, EPA seeks comment on how it might structure a program that could reduce GHG emissions from transportation fuel over and above those reductions that could be achieved by the RFS and anticipated EISA requirements.

VII. Stationary Source Authorities and Potential Options for Regulating Greenhouse Gases under the Clean Air Act

In this section, we explore three major pathways that the CAA provides for regulating stationary sources, as well as other stationary source authorities of the Act, and their potential applicability to GHGs. The three pathways include NAAQS and implementation plans (sections 107-110 and related provisions); performance standards for new and existing stationary sources (section 111); and hazardous air pollutant standards for stationary sources (section 112).[228] Special provisions for regulating solid waste incinerators are contained in section 129.

We also review the implications of regulating GHGs under Act's programs for preconstruction permitting of new emissions sources, with emphasis on the PSD program under Part C of the Act. These programs require permits and emission controls for major new sources and modifications of existing major sources. The permitting discussion closes by examining the implications of requiring operating permits under Title V for major sources of GHGs. Finally, we describe four different types of market-oriented regulatory designs that (in addition to other forms of regulation) could be considered for programs to reduce GHG emissions from stationary sources to the extent permissible under the CAA: cap-and-trade, rate-based emissions trading, emissions fees, and a hybrid approach.

[228] As explained in this section, the NAAQS pathway is not solely a stationary source regulatory authority; plans for implementating the NAAQS can involve regulation of stationary and mobile sources.

For each potential pathway of stationary source regulation, this notice discusses the following basic questions:

- What does the section require?
- What sources would be affected if GHGs were regulated under this authority?
- What would be the key milestones and implementation timeline?
- What are key considerations regarding use of this authority for GHGs and how could potential issues be addressed?
- What possible implications would use of this authority for GHGs have for other CAA programs?

In discussing these questions, EPA considers the President's core principles and other policy design principles enumerated in Section III.F.1. EPA seeks comment on the advantages and disadvantages of alternative regulatory authorities in light of those policy design principles. EPA further invites comments on the following aspects of each CAA stationary source authority:

- How much flexibility does the CAA section provide for implementing its requirements? For example, can EPA set compliance dates that reflect the global and long-lived nature of GHGs and that allow time for technological advances and new technology deployment?
- To what extent would the section allow for consideration of the costs and economic impacts of regulating GHGs? For example, would the section provide opportunities for sending a price signal, such as through cap and trade programs (with or without cost containment mechanisms) and emission fees.

- To what extent can each section account for the international aspects of GHG emissions, atmospheric concentrations, and emission impacts, including ways for potentially addressing international pollutant transport and emission leakage?
- How does each section address the assessment of available technologies, and to what extent could the section promote or require the advancement of technology?
- To what extent does the section allow for the ability to prioritize regulation of significant emitting sectors and sources?
- To what extent could each authority be adapted to GHG regulation without compromising the Act's effectiveness in regulating traditional air pollutants?

Finally, for each regulatory authority, EPA requests comment on a range of program-specific issues identified in the discussion below. EPA also requests comment on whether there are specific statutory limitations that would best be addressed by new legislation. Additional information concerning potential CAA regulation of stationary source GHGs may be found in the Stationary Source Technical Support Document (Stationary Source TSD) placed in the docket for this notice.

A. National Ambient Air Quality Standards (NAAQS)

1. What are the Requirements for Setting and Implementing NAAQS?

a. Section 108: Listing Pollutant(s) and Issuing Air Quality Criteria

Section 108(a)(1) establishes three criteria for listing air pollutants to be regulated through NAAQS. Specifically, section 108(a)(1) states that: EPA "shall from time to time … list … each air pollutant—

> (A) emissions of which, in [the Administrator's] judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare;
>
> (B) the presence of which in the ambient air results from numerous or diverse mobile or stationary sources; and
>
> (C) for which air quality criteria had not been issued before the date of enactment of the Clean Air Amendments of 1970, but for which [the Administrator] plans to issue air quality criteria under this section."

In determining whether a pollutant meets these criteria, EPA must consider a number of issues, including many of those discussed in section IV above regarding an endangerment finding. As discussed there, in the context of the ICTA petition remand, EPA is considering defining the "air pollution" as the elevated current and future concentration of six GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6). Also in that context, EPA is considering alternative definitions of "air pollutant" as the group of GHGs or each individual GHG for purposes of the "cause or contribute" determination.

In considering the potential listing of GHGs under section 108, EPA solicits input on appropriate definitions of both the "air pollution" and the "air pollutants." With regard to section 108, it is important to note that EPA has clear precedents for listing related compounds as groups rather than as individual pollutants. For example, photochemical oxidants, oxides of nitrogen, and particulate matter all comprise multiple compounds, but the listing under section 108 is for the group of compounds, not the individual elements of the group. The Agency is soliciting comment on the relevance of these precedents for GHGs. In addition, as discussed later, there would be increased complexity in setting NAAQS for individual GHGs than for GHGs as a group. We are particularly interested in comments on how to apply the terms "air pollution" and/or "air pollutants" under sections 108 and 109 in the context of GHGs, and the implications of taking consistent or different approaches under other Titles or sections of the Act.

A positive endangerment finding for GHGs under section 202(a) or other sections of the CAA could have significant and direct impacts on EPA's consideration of the first two criteria for listing the pollutant(s) under section 108, as explained in section IV.B.2 of this notice. The third criterion for listing under section 108, however, may be unrelated to the issues involved in any motor vehicle or other endangerment finding. Moreover, this third criterion could provide EPA discretion to decide whether to list those pollutants under section 108 for purposes of regulating them via the NAAQS.[229] EPA requests comment on the effect of a positive finding of endangerment for GHGs under section 202(a) of the Act on potential listing of the pollutant(s) under section 108.

Section 108 also requires that once a pollutant is listed, EPA issue "air quality criteria" encompassing "all identifiable effects on public health or welfare," including interactions between the pollutant and other types of pollutants in the atmosphere. We are interested in commenters' views on whether and how developing air quality criteria

[229] With respect to the third criterion , while there is a decision of U.S. Court of Appeals for the Second Circuit to the contrary, NRDC v. Train, 545 F.2d 320 (2nd Cir. 1978), EPA notes that that decision was rendered prior to the Supreme Court's decision in *Chevron v. Natural Resources Defense Council.* 467 U.S. 837 (1984). Thus, a proper and reasonable question to ask is whether this criterion affords EPA discretion to decide whether it is appropriate to apply the NAAQS structure to a global air pollution problem like GHGs.

for GHGs would differ from developing such criteria for other pollutants such as ozone and particular matter, given the long-lived nature of GHGs and the breadth of impacts and other special issues involved with global climate change. EPA also invites comment on the extent to which it would be appropriate to use the most recent IPCC reports, including the chapters focusing on North America, and the U.S. government Climate Change Science Program synthesis reports as scientific assessments that could serve as an important source or as the primary basis for the Agency's issuance of "air quality criteria."

Finally, section 108 requires EPA to issue information on air pollution control techniques at the same time it issues air quality criteria. This would include information on the cost of installation and operation, energy requirements, emission reduction benefits, and environmental impacts of these techniques. Generally, the Agency defers this obligation until the time a standard is actually issued. As required under Executive Order 12866, EPA must issue a Regulatory Impact Analysis (RIA) for major rulemaking actions, and it is in this context that EPA has previously described the scope and effectiveness of available pollution control techniques. EPA requests comment on whether this approach is appropriate in the case of GHGs.

b. Section 109: Standard-Setting

Section 109 requires that the Administrator establish NAAQS for any air pollutant for which air quality criteria are issued under section 108. Both the air quality criteria and the standards are to be reviewed and, as appropriate, revised by the Administrator, every five years. These decisions are to be informed by an independent scientific review committee, a role which has been fulfilled by the Clean Air Scientific Advisory Committee (CASAC) of EPA's Science Advisory Board. The committee is charged with reviewing both the air quality criteria for the pollutant(s) and the standards, and recommending any revisions deemed appropriate.

The statute specifically provides that primary NAAQS "shall be ambient air quality standards the attainment and maintenance of which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health," including the health of sensitive groups. The requirement that primary standards provide an adequate margin of safety was intended to address uncertainties associated with inconclusive scientific and technical information available at the time of standard setting. It was also intended to provide a reasonable degree of protection against hazards that research has not yet identified. Lead Industries Association v. EPA, 647 F.2d 1130, 1154 (DC Cir 1980), cert. denied, 449 U.S. 1042 (1980); American Petroleum Institute v. Costle, 665 F.2d 1176, 1186 (DC Cir 1981), *cert. denied*, 455 U.S. 1034 (1982). The selection of any particular approach to providing an adequate margin of safety is a policy choice left specifically to the Administrator's judgment. Lead Industries Association v. EPA, 647 F.2d at 1161-62.

With regard to secondary NAAQS, the statute provides that these standards "specify a level of air quality the attainment and maintenance of which in the judgment of the Administrator ... is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air." Welfare effects as defined in CAA section 302(h) include, but are not limited to, “effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being.”

One of the central issues posed by potential regulation of GHGs through the NAAQS is the nature of the health and environmental effects to be addressed by the standards and, thus, what effects should be addressed when considering a primary (public health) standard and what effects should be addressed when considering a secondary (public welfare) standard. This issue has implications for whether it would be appropriate to establish a primary standard as well as a secondary standard for these pollutants. As discussed above in section V, the direct effects of GHG emissions appear to be principally or exclusively welfare-related. GHGs are unlike other current NAAQS pollutants in that direct exposure to GHGs at current or projected ambient levels appears to have no known adverse effects on human health. Rather, the health impacts associated with ambient GHG concentrations are a result of the changes in climate at the global, regional, and local levels, which trigger myriad ecological and meteorological changes that can adversely affect public health (e.g., increased viability or altered geographical range of pests or diseases; increased frequency or severity of severe weather events including heat waves) (see section V above). The effects on human health are thus indirect impacts resulting from these ecological and meteorological changes, which are effects on welfare. This raises the question of whether it is more appropriate to address these health effects as part of our consideration of the welfare effects of GHGs when setting a secondary NAAQS rather than a primary NAAQS. Control of GHGs would then occur through implementation of the secondary NAAQS rather than the primary NAAQS. EPA invites comment on whether and how these indirect human health impacts should be addressed in the context of setting a primary or a secondary NAAQS.

Past experience suggests EPA may have discretion to decline to set either a primary or a secondary standard for a pollutant if the evidence shows that there are no relevant adverse effects at or near current ambient concentrations, and therefore that no standard would be requisite to protect public health or welfare. In 1985, for example, EPA determined that it was appropriate to revoke the secondary standard for carbon monoxide (CO) after a review of the scientific evidence indicated that there was no evidence of known or anticipated adverse welfare effects associated with CO at or near ambient levels. 50 FR 37484, 37494 (September 13, 1985). This decision was reaffirmed by the Agency in the 1994 CO NAAQS review, and there remains only a primary standard for this pollutant. EPA requests comment on whether it would be necessary and/or appropriate for the Agency to establish both primary and secondary NAAQS for GHGs if those pollutants were listed under section 108.

It is also important to consider how a NAAQS for GHGs would interface with existing NAAQS for other pollutants, particularly oxides of nitrogen (NOx) and ozone (O_3), as well as particulate matter. EPA's approach in other NAAQS reviews has been to consider climate impacts associated with any pollutant as part of the welfare impacts evaluated for that pollutant in setting secondary standards for the pollutant. If separate NAAQS were established for GHGs, EPA would likely address the climate impacts of each specific GHG in the NAAQS for GHGs, and would not need to address the climate impacts of that GHG when addressing other NAAQS, thus avoiding duplication of effort.

In considering the application of section 109 to GHGs and whether it would be appropriate to regulate GHGs through the NAAQS, EPA must evaluate a number of other standard-setting issues, as discussed below.

i. Level

For potential GHG standards, EPA would face special challenges in determining the level of the NAAQS. As noted above, the primary standard must be "requisite to protect public health with an adequate margin of safety" and the secondary standard "requisite to protect public welfare against any known or anticipated adverse effects." EPA's task is to establish standards that are neither more nor less stringent than necessary for the purposes of protecting public health or welfare. Whitman v. American Trucking Associations, 531 U.S. 457, 473. Under established legal interpretation, the costs of implementation associated with various potential levels cannot be factored into setting a primary or secondary standard.[230] Any determinations by the EPA Administrator regarding the appropriate level (and other elements of) of a NAAQS for GHGs must based on the available scientific evidence of adverse public health and/or public welfare impacts, without consideration of the costs of implementation.

[230] The Supreme Court has confirmed EPA's long-standing interpretation and ruled that "[t]he text of §109(b), interpreted in its statutory and historical context and with appreciation for its importance to the CAA as a whole, unambiguously bars cost considerations from the NAAQS-setting process." The court also noted that consideration of costs occurs the state's formulation of the implementation plan with the aid of EPA cost data. *Whitman v. American Trucking Associations*, 531 U.S. at 472.

EPA expects it would be difficult to determine what levels and other elements of NAAQS would meet these criteria for GHGs, given that the full effects associated with elevated atmospheric concentrations of these pollutants occur over a long period of time and there are significant uncertainties associated with the health or welfare impacts at any given concentration. The delayed nature of effects and the complex feedback loops associated with global climate change would require EPA to consider both the current effects and the future effects associated with current ambient concentrations. In making a determination of what standard is sufficient but not more stringent than necessary, EPA would also have to grapple with significant scientific uncertainty. As with other NAAQS, however, the iterative nature of the 5-year review cycle means the standards could be revised as appropriate in light of new scientific information as it becomes available. EPA requests comment on the scientific, technical, and policy challenges of determining appropriate levels for NAAQS for GHG pollutants, for both primary and secondary standards.

As with all pollutants for which EPA establishes NAAQS, EPA would need to evaluate what constitutes an “adverse” impact in the climate context. EPA notes that the 1992 UNFCCC calls for the avoidance of “dangerous anthropogenic interference with the climate system.” However, it is possible that the criteria for setting a NAAQS may call for protection against risks and effects that are less egregious than “dangerous interference.” Furthermore, international agreement has not been reached on either the metric (e.g., atmospheric concentrations of the six major directly emitted anthropogenic GHGs, radiative forcing, global average temperature increase) or the level at which dangerous interference would occur. EPA requests comment on whether it would be appropriate, given the unique attributes of GHGs and the significant contribution to total atmospheric GHG contributions from emissions emanating outside the United States, to establish a level for a GHG NAAQS based on an internationally agreed-upon target GHG level, considering legal and policy factors.

Another key question is the geographical extent of the human health and welfare effects that should be taken into consideration in determining what level and other elements of a standard would provide the appropriate protection. The pollutants already subject to NAAQS are typically local and/or regional in nature, so the standards are designed to limit ambient concentrations of pollutants associated with emissions typically originating in and affecting various parts of the United States. In assessing what standard is requisite to protect either public health or welfare, EPA has focused in the past on analyzing and addressing the impacts in the United States. It may be appropriate to interpret the Act as requiring standards that are requisite for the protection of U.S. public health and welfare. However, atmospheric concentrations of GHGs are relatively uniform around the globe, the impacts of climate change are global in nature, and these effects, as described in section V, may be unequally distributed around the world. The severity of impacts in the U.S. might differ from the severity of impacts in the rest of the world. In light of these factors, EPA invites comment on whether it would be appropriate to consider adverse effects on human health and welfare occurring outside the U.S. Specifically, we invite comment on whether, and if so, on what legal basis, it would be appropriate for EPA to consider impacts occurring outside the U.S. when those impacts, either in the short or long term, may reasonably be anticipated to have an adverse effect on health or welfare in the U.S.

As noted briefly above, if each GHG is listed as a separate pollutant under section 108, rather than as a group or category of pollutants, then EPA arguably would have to establish separate NAAQS for each listed GHG. This scenario raises significant challenges for determining which level of any particular standard is appropriate, especially as the science of global climate change is generally focused on the total radiative impact of the combined concentration of GHGs in the atmosphere. Since for any one pollutant, the standard that is requisite to protect public health with an adequate margin of safety or public welfare from known or anticipated adverse effects is highly dependent upon the concentration of other GHGs in the atmosphere, it would be difficult to establish independent standards for any of the six principal GHGs. EPA requests comments on possible approaches for determining appropriate levels for GHG NAAQS if these pollutants are listed individually under section 108.

ii. Indicator

If each GHG is listed as an individual pollutant under section 108, the atmospheric concentration of each pollutant could be measured separately, and establishing an indicator for each pollutant would be straightforward. However, if GHGs are listed as a group, it would be more challenging to determine the appropriate indicator for use in measuring ambient air quality in comparison to a GHG NAAQS. One approach could be to measure the total atmospheric concentration of a group of GHGs on a CO_2 equivalent basis, by assessing their total radiative forcing (measured in W/m^2).[231] Radiative forcing is a measure of the heating effect caused by the buildup of the GHGs in

[231] See footnote 13 for an explanation of CO_2 equivalency.

the atmosphere. Estimating CO_2-equivalent atmospheric *concentrations,* however, would not be a simple matter of multiplying emissions times their respective GWP values. Rather, the heating effect (radiative forcing) due to concentrations of each individual GHG would have to be estimated to define CO_2-equivalent concentrations. EPA invites comment on the extent to which radiative forcing could be an effective metric for capturing the heating effect of all GHGs in a group (or for each GHG individually). For example, in the year 2005 global atmospheric CO_2 concentrations were 379 parts per million (ppm), but the CO_2-equivalent concentration of all long-lived GHGs was 455 ppm. This approach would not require EPA to specify the allowable level of any particular GHG, alone or in relation to the concentration of other GHGs present in the atmosphere.

A second option would be to select one GHG as the indicator for the larger group of pollutants intended to be controlled under the standard. This kind of indicator approach is currently used in regulating photochemical oxidants, for which ozone is the indicator, and oxides of nitrogen, for which NO_2 has been used as an indicator. There are several reasons, however, that this approach may not be appropriate for GHGs. For example, in the instances noted above, the indicator species is directly related to the other pollutants in the group, either through common precursors or similar chemical composition, and there is a basis for expecting that control of the indicator compound will lead to the appropriate degree of control for the other compounds in the listed pollutant. In the case of GHGs, it would be more difficult to select one species as the indicator for the larger group, given that the GHGs are distinct in origin, chemical composition, and radiative forcing, and will require different control strategies.

Furthermore, this approach raises an issue regarding whether states would have the appropriate incentive to address all pollutants within the group. For example, there could be a focus on controlling the single indicator species at the expense of other species also associated with the adverse effects from which the standard(s) are designed to offer protection.

EPA seeks comment on the merits and drawbacks of these various approaches, as well as suggestions for other possible approaches, to defining an indicator for measuring allowable concentrations of GHGs in the atmosphere.

c. Section 107: Area Designations

After EPA establishes or revises a NAAQS, the CAA requires EPA and the states to begin taking steps to ensure that the new or revised NAAQS are met. The first step is to identify areas of the country that do not meet the new or revised NAAQS. This applies to both the primary and secondary NAAQS. EPA is required to identify each area of the country as "attainment," "nonattainment," or "unclassifiable."[232]

[232] CAA Section 107(d)(1) requires EPA to establish a deadline for states to submit recommendations for area designations that is no later than one year after promulgation of the new or revised NAAQS. Section 107(d)(1) also directs states to recommend appropriate area boundaries. A nonattainment area must consist of that area that does not meet the new or revised NAAQS, and the area that contributes to ambient air quality in a nearby area that does not meet the new or revised NAAQS. Thus, a key factor in setting boundaries for nonattainment areas is determining the geographic extent of nearby source areas contributing to the nonattainment problem. EPA then reviews the states' recommendations, collects and assesses additional information as appropriate, and issues final designations no later than 2 years following the date EPA promulgated the new or revised NAAQS. EPA may take one additional year (meaning final designations can be up to 3 years after promulgation of new or revised NAAQS) if the Administrator has insufficient information to promulgate the designations. Whether or not a state or a Tribe provides a recommendation, EPA must promulgate the designation that it deems appropriate.

For a GHG NAAQS, the designations given to areas would depend on the level of the NAAQS and the availability of ambient data to make informed decisions for each area. For GHGs, in contrast to current NAAQS pollutants, it would likely make sense to conduct the air quality assessment at the national scale rather than at a more localized scale. All of the potential indicators discussed above for measuring ambient concentrations of GHGs for purposes of a NAAQS involve globally averaged metrics. Therefore, the ambient concentrations measured across all locations within the U.S. for purposes of comparison to the level of the standard would not vary, and all areas of the country would have the same designation—that is, the entire U.S. would be designated either attainment or non-attainment, depending on the level of the NAAQS compared to observed GHG ambient concentrations.

If, in making decisions about the appropriate level of the GHG NAAQS, EPA were to determine that current ambient concentrations are not sufficient to cause known or anticipated adverse impacts on human health or welfare now or in the future, then it is possible that the NAAQS would be set at some level higher than current ambient concentrations. In that case, the entire country would likely be designated nonattainment. If, on the other hand, EPA were to set the NAAQS at a level above current ambient concentrations, the entire country would likely be designated attainment.

d. Section 110: State and Federal Implementation Plans

i. State Implementation Plans

The CAA assigns important roles to EPA, states, and tribal governments in implementing NAAQS and in ensuring visibility protection in Class I areas. States have the primary responsibility for developing and implementing state implementation plans (SIPs). A SIP is the compilation of authorities, regulations, control programs, and other measures that a state uses to carry out its responsibilities under the CAA to attain, maintain, and enforce the NAAQS and visibility protection goals, and to prevent significant deterioration of air quality in areas meeting the standard. Additional specifics on SIP requirements are contained in other parts of the CAA.

EPA assists states and tribes in their efforts to clean the air by promulgating national emissions standards for mobile sources and selected categories of stationary sources. Also, EPA assists the states in developing their plans by providing technical tools, assistance, and guidance, including information on potentially applicable emissions control measures.

Historically, the pollutants addressed by the SIP program have been local and regional pollutants rather than globally mixed pollutants like GHGs. The SIP development process, because it relies in large part on individual states, is not designed to result in a uniform national program of emissions controls.

(1) Generic requirements for all SIPs

This section discusses the specific CAA requirements states must address when implementing any new or revised NAAQS.[233]

Under section 110(a)(1) and (2) of the CAA, all states are required to submit plans to provide for the implementation, maintenance, and enforcement of any new or revised NAAQS. Section 110(a)(1) and (2) require states to address basic program elements, including requirements for emissions inventories, monitoring, and modeling, among other things. These requirements apply to all areas of the state regardless of whether those areas are designated nonattainment for the NAAQS.

In general, every state is required to submit to EPA within 3 years of the promulgation of any new or revised NAAQS a SIP demonstrating that these basic program elements are properly addressed. Subsections (A) through (M) of section 110(a)(2) enumerate the elements that a state's program must contain. See the Stationary Source TSD for this list.

Other statutory requirements for state implementation plans vary depending on whether an area is in nonattainment or attainment. There are four specific scenarios that could hypothetically apply, depending on whether a primary or a secondary standard, or both, are established, and on the level(s) set for those standards. Because we are proposing no scientific determinations in this notice, our discussion of NAAQS implementation addresses all four of these scenarios.

(2) Scenario 1: Primary GHG standard with country in nonattainment

[233] The visibility protection program required by CAA sections 169A and 169B, and as implemented through state compliance with EPA's 1999 Regional Haze Rule, will only be raised again here in this section of the ANPR in the context of a framework for implementing a secondary GHG NAAQS.

If the entire country were designated nonattainment for a primary GHG NAAQS, each state would be required to develop and submit a SIP that provided for attainment and met the other specific requirements of Part D of Title I of the Act by the specified deadline.

Requirements for the general contents of a nonattainment area plan are set forth in section 172 of the CAA. Section 172(c) specifies that SIPs must, among other things:[234]

- include all Reasonably Available Control Measures (RACM) (including, at a minimum, emissions reductions obtained through adoption of Reasonably Available Control Technology (RACT)) and provide for attainment of the NAAQS;
- provide for Reasonable Further Progress (RFP), which means reasonable interim progress toward attainment;
- include an emissions inventory;
- require permits for the construction and operation of major new or modified stationary sources, known as “nonattainment new source review” (see also section 173 of the Act and section VII.E. of this notice);
- contain contingency measures that are to be implemented in the event the air quality standard is not met by the area’s attainment deadline; and
- meet the applicable provisions of section 110(a)(2) of the CAA related to the general implementation of a new or revised NAAQS.

In addition, all nonattainment areas must meet requirements of section 176(c) known as "general conformity" and "transportation conformity." [235] In brief, general conformity

[234] For additional information about nonattainment area planning requirements, please see the Technical Support Document.

requires the federal government only to provide financial assistance, issue a permit or approve an activity that conforms to an approved SIP for a NAAQS. Transportation conformity requires metropolitan planning organizations and the U.S. Department of Transportation only to approve or fund transportation plans, programs and projects that conform to an approved SIP for a NAAQS. For the scenario of the country in nonattainment with a GHG NAAQS, these requirements would apply nationwide one year after the effective date of EPA's nonattainment designations.

For nonattainment areas, SIPs must provide for attainment of the primary NAAQS as expeditiously as practicable, but no later than 5 years from the effective date of the nonattainment designation for the area – or no later than 10 years if EPA finds additional time is needed considering the severity of nonattainment and the availability and feasibility of pollution control measures.

At the outset, it would appear to be an inescapable conclusion that the maximum 10-year horizon for attaining the primary NAAQS would be ill-suited to GHGs. The long atmospheric lifetime of the six major emitted GHGs means that atmospheric concentrations will not quickly respond to emissions reduction measures (with the possible exception of methane, which has an atmospheric lifetime of approximately a decade). In addition, in the absence of substantial cuts in worldwide emissions, worldwide concentrations of GHGs would continue to increase despite any U.S. emission control efforts. Thus, despite active control efforts to meet a NAAQS, the entire U.S. would remain in nonattainment for an unknown number of years. If States were unable to develop plans demonstrating attainment by the required date, the result would be long-

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[235] These requirements also apply to "maintenance areas" -- former nonattainment areas that have met the standard and been redesignated according to a formal EPA determination.

term application of sanctions, nationwide (e.g., more stringent offset requirements and restrictions on highway funding), as well as restrictions on approvals of transportation projects and programs related to transportation conformity. EPA is currently evaluating the extent to which section 179B might provide relief to states in this circumstance. As further explained below, section 179B is a waiver provision providing for SIP approval under certain circumstances when international emissions affect a U.S. nonattainment area.

In addition to submitting plans providing for attainment within the state, each state would be required to submit, within 3 years of NAAQS promulgation, a plan under section 110(a)(2)(D) prohibiting emissions that would significantly contribute to nonattainment in another state. EPA requests comments on what approaches could be utilized for purposes of addressing this requirement as well as the general matter of controlling GHGs to meet a NAAQS.

Impact of section 179B on nonattainment requirements :States may use section 179B of the CAA to acknowledge the impact of emissions from international sources that may contribute to violations of a NAAQS. Section 179B provides that EPA shall approve a SIP for a nonattainment area if: (1) the SIP meets all applicable requirements of the CAA; and (2) the submitting state can satisfactorily demonstrate that "but for emissions emanating from outside of the United States," the area would attain and maintain the applicable NAAQS. EPA has historically evaluated these "but for" demonstrations on a case-by-case basis, based on the individual circumstances and the data provided by the submitting state. These data might include ambient air quality monitoring data, modeling scenarios, emissions inventory data, and meteorological or satellite data. In the case of GHGs, however, where global emissions impact all areas within the United States, the federal government may be best suited for establishing whether a “but for” demonstration can be made for the entire country.

If a “but for” conclusion is affirmed, section 179B would allow EPA to approve a SIP that did not demonstrate attainment or maintenance of the relevant NAAQS. Section 179B does not provide authority to exclude monitoring data influenced by international transport from regulatory determinations related to an area’s status as an attainment or nonattainment area. Thus, even if EPA approves a section 179B "but for" demonstration for an area, the area would continue to be designated as nonattainment and subject to certain applicable nonattainment area requirements, including nonattainment new source review, conformity, and other measures prescribed for nonattainment areas by the CAA. EPA requests comment on the practical effect of application of section 179B on the global problem of GHG emissions and on the potential for controls based on the attainment plan requirement and other requirements directly related to the attainment requirement, including the reasonable further progress requirement and the RACM requirement.[236]

(3) Scenario 2: Secondary standard with country in nonattainment (no primary standard)

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[236] EPA has interpreted RACM as emissions reducing measures that are technically and economically feasible, and considered collectively would advance the nonattainment area’s attainment date by at least one year. RACT has been interpreted in two different ways, depending on the applicable statutory requirements. In the case of ozone, RACT consists of measures that are technically and economically feasible, without regard to whether the measures would result in earlier attainment. In recent rules on PM2.5, EPA interpreted RACT for PM2.5 as essentially the same as RACM, with RACT referring to the stationary source component of RACM, which applies to all types of sources.

As noted above in the NAAQS standard-setting discussion, depending on the nature and bases of any endangerment finding under section 108, EPA may be able to consider setting only a secondary NAAQS for GHGs and not also a primary NAAQS.

In general, the same nonattainment requirements that apply to SIPs for a primary standard apply for a secondary standard, including nonattainment new source review and the other programs listed under the Scenario 1 subsection above.

A notable difference in nonattainment requirements for primary and secondary standards is the time allowed for attainment. Under a secondary standard, state plans must achieve attainment as expeditiously as practicable, but there is no statutory maximum date for attainment. The general requirement to attain as expeditiously as practicable includes consideration of required controls, including "reasonably available control measures." These requirements do allow for consideration of cost. What would constitute "as expeditiously as practicable" would be determined based on the entire set of facts and circumstances at issue. EPA requests comment on how to interpret the requirement that state plans demonstrate that attainment will be achieved "as expeditiously as practicable" in the context of a secondary NAAQS for GHGs.

Potential implementation approach based on regional haze model : For a secondary GHG NAAQS with no prescribed attainment date, EPA requests comment on the concept of implementing a GHG secondary NAAQS standard in a way roughly analogous to an approach used in the long-term regional visibility program, known as the regional haze program. This program is based on a goal of achieving natural visibility conditions in our nation's parks and wilderness areas (Class I areas) by 2064. The program requires states to develop reasonable progress goals every 10 years and implement emissions control programs to achieve those goals, ultimately achieving the 2064 natural condition goal in each Class I area. At the midpoint of every 10-year period, states must assess the progress being made and take corrective action if necessary to maintain reasonable progress toward the 10-year progress milestone.

The regional haze program's model for goal planning, control strategy development, and control strategy implementation could offer a possible framework for achieving a GHG secondary NAAQS. This framework potentially could be designed to address the RACM, RACT and Reasonable Further Progress requirements, as well as the attainment planning requirement. This framework may also provide a mechanism for implementing a nationwide GHG emissions cap and trade program adopted and implemented through state plans. However, EPA recognizes that the global nature of GHGs and their persistence in the atmosphere make an approach based on "reasonable" progress more difficult to implement than in the case of regional haze. For example, despite domestic emissions reductions, it might not be possible to discern improvement in atmospheric concentrations of GHGs due to their relatively long atmospheric lifetimes or to growth in emissions from other countries which could eclipse reductions made in the U.S. We note that using this framework would not provide relief from any of the applicable nonattainment area requirements of the Act. EPA requests comment on whether, and if so how, the regional haze approach could be adapted for use in the GHG context.

(4) Scenarios 3 and 4: Primary and/or secondary standard with country in attainment

If a primary or secondary GHG NAAQS were set at a level higher than ambient GHG levels at the time of designations, then the country would be in attainment. (See preceding section on NAAQS standard-setting for discussion of this issue.) In this case, a much shorter list of requirements would apply than if the country were in nonattainment.

SIPs would be required to include PSD programs for GHGs, which would require preconstruction permitting of new major sources and significant modifications to existing major sources. (See section VII.D on PSD.)

EPA has identified two other requirements that potentially could apply, both of which could provide authority for a nationwide cap-and-trade program implemented at the state level. First, section 110(a)(1) requires states to submit a SIP providing for "implementation, maintenance, and enforcement" of primary and secondary NAAQS. Under the scenario of a GHG NAAQS with the country in attainment, where states may need more than PSD/NSR to maintain attainment, EPA could consider using this provision to require SIPs to provide for maintenance of air quality consistent with the GHG standard. This requirement could be implemented through a nationwide cap-and-trade program designed at the federal level and adopted by individual states in their SIPs, a program similar but broader in scope than existing programs such as the more limited NOx SIP Call regional cap-and-trade system for EGUs and selected industrial source categories. If a state failed to submit an adequate maintenance SIP, EPA would be required to develop and implement a federal implementation plan for that state. EPA could design the FIP to enable the state to participate in a nationwide cap-and-trade system.

Second, section 110(a)(2)(D) requires SIPs to prohibit emissions that would interfere with maintenance of the standard by other states. Because GHGs are globally well-mixed, it may be that GHGs emitted from any state could be found to interfere with maintenance of a GHG NAAQS in every other state. In the past, EPA has issued rules that have resulted in states adopting interstate cap-and-trade programs (e.g., the Clean Air Interstate Rule) implemented through SIPs to address the requirements of this provision. In the case of GHGs, this authority could potentially support a nationwide cap-and-trade program for GHGs, adopted through SIPs. If a state failed to submit its section 110(a)(2)(D) SIP, EPA would be required to develop and implement a FIP for that state. EPA could design the FIP to enable the state to participate voluntarily in a nationwide cap-and-trade system. We request comment on the suitability of adopting either of these approaches under section 110(a).

ii. Additional CAA provisions affecting SIP obligations and FIPs

(1) Section 179(a)

The CAA requires states to submit SIPs to EPA for review, and EPA must approve or disapprove them based on whether the state plan or component meets the Act's requirements. An EPA finding that a state has failed to submit a nonattainment plan or plan component, or an EPA disapproval of such a plan because it does not meet the requirements of the Act, would start a "sanctions clock" under section 179(a). This means that sanctions would apply in the state if the deficiencies are not corrected within prescribed deadlines. These sanctions include additional requirements for major new sources (18 months after the finding of failure) and restrictions on federal highway funds (6 months after the offset sanction).[237] EPA must promulgate a FIP for the deficient component of the SIP if the state's plan component is not approved within 2 years of EPA's finding or disapproval action. In the case of GHGs, it is possible that EPA could design the FIP to enable the state to participate in a nationwide cap-and-trade system.

(2) Section 115

CAA section 115 creates a mechanism through which EPA can require states to amend their SIPs to address international transport issues. It is designed to protect public health and welfare in another country from air pollution emitted in the U.S. provided the U.S. is given essentially reciprocal rights with respect to prevention and control of air pollution originating in the other country. The Administrator could exercise his authority under this provision if EPA were to promulgate a NAAQS for GHG.

To act under section 115, the Administrator would need to make a finding that, based on information from any duly constituted international agency, he has reason to believe that air pollutants (GHGs) emitted in the U.S. causes or contributes to air pollution which may reasonably be anticipated to endanger public health or welfare in a foreign country. Upon making such a finding, the Administrator would give formal notification to the Governor of the state (or in this case potentially all of the states) where GHGs originate. A finding under this section has the same regulatory consequences as a finding that the state's existing SIP is inadequate to attain the NAAQS or otherwise meet

[237] 40 CFR 52.31.

the requirements of the Act. This notification would require the notified states to modify their SIPs to prevent or eliminate the endangerment.

Addressing GHGs under this authority could allow some flexibility in program design, subject to limitations of the SIP development process. Section 115 could not be used to require states to incorporate into their SIPs measures unrelated to attainment or maintenance of a NAAQS. A factor to consider is that this section of the Act only applies where countries that suffer possible endangerment give reciprocal rights to the U.S. However, reciprocity with one or more affected countries may be sufficient to trigger section 115. We request comment on the efficacy of using section 115 as a mechanism to facilitate more effective regulation of GHGs through a NAAQS.

2. What Sources would be Affected?

Sections 108 and 109 impose no controls directly on sources, but instead establish the air quality benchmarks that control requirements would be designed to meet. The precise nature of these controls would be determined through federal and state programs, as established via SIPs and, for states failing to submit an approvable plan, FIPs. Considering that GHGs are emitted by a wide array of sources, it is likely that NAAQS implementation would result in controls on numerous stationary and mobile sources through sections 110 and 172.

The federal government could have less flexibility under the NAAQS approach to target control efforts toward particular groups of existing stationary sources. Under the traditional SIP approach, emissions controls on specific source categories would flow from independent state-level decisions, and could result in a patchwork of regulations requiring different types and levels of controls in different states. However, the SIP approach could also be adapted for use in a more coordinated strategy. As mentioned above, EPA has in the past issued rules that have resulted in states adopting limited interstate cap-and-trade programs (e.g., NOx SIP Call and the Clean Air Interstate Rule) implemented through state SIPs. Furthermore, the federal government would also have flexibility to design a national control program in the event that states did not adopt the required programs and EPA were required to promulgate a FIP.

EPA requests comment on whether and how the different implementation provisions within the NAAQS program could be adapted to be most suitable for application to control GHGs.

3. What Would Be the Key Milestones and Implementation Timeline?

The key milestones that would apply if EPA were to regulate GHGs as a NAAQS pollutant include: listing the pollutant(s); issuing air quality criteria; issuing information on air pollution control techniques; proposing primary and secondary NAAQS for the pollutants; issuing final standards; designating areas; development of SIPs/FIPs; and application of control measures.

EPA has discretion with regard to the date of listing of a pollutant under section 108. The statute does not prescribe any specific deadline for listing, instead stating that EPA “shall from time to time … list … each air pollutant” that EPA judges meets the three criteria discussed above. This could provide the Agency some latitude in determining the precise timing of any listing.

Once a pollutant is listed, the CAA specifies a very ambitious timeline for issuing the initial NAAQS for the pollutant. Section 108 allows 12 months between date of listing and issuance of air quality criteria for the pollutant(s). Since these criteria are intended to encompass "all identifiable effects on public health or welfare," it would be difficult to meet this timeline in the case of GHGs. In 1970, when the NAAQS program was first established under the CAA, air quality criteria either were in development or had already been issued for a variety of pollutants, and the process involved consideration of a much smaller body of science than is now available. Therefore, the 12-month period allotted for the initial issuance of air quality criteria appeared reasonable.[238] However, based on recent NAAQS reviews for ozone, particulate matter, lead, and other pollutants, it now generally takes several years for the Agency to complete the thorough scientific assessment necessary to issue air quality criteria.

Given the complexity of global climate change science, and the vast amount of research that would be relevant to the Agency's scientific assessment, EPA anticipates this task would be particularly time consuming in the case of GHGs, though relying on synthesis reports such as the Intergovernmental Panel on Climate Change's Fourth Assessment Report and various reports of the US Climate Change Science Program could help expedite the process. The challenge of completing a thorough scientific assessment for GHGs could result in a significant delay in listing the pollutant(s) under section 108,

[238] For each air pollutant for which air quality criteria had already been issued prior to enactment of the Clean Air Act Amendments of 1970, section 109(a)(1) actually required EPA to issue proposed NAAQS within 30 days of enactment and to finalize those standards within 90 days of publication of the proposal. This included carbon monoxide, ozone, particulate matter, hydrocarbons, and sulfur oxides.

since EPA would likely choose to list GHGs only when the scientific assessment had progressed sufficiently to enable the Agency to meet the statutory requirement to issue "air quality criteria" within one year of listing, and to meet the tight rulemaking timeframe, discussed below. To the extent that EPA addresses GHGs through this CAA mechanism, EPA requests comments on the issuance of "air quality criteria" following listing, as well as the adequacy of the available scientific literature.

Under section 109, EPA must propose NAAQS for any newly listed pollutant at the same time it issues air quality criteria under section 108, and must finalize those standards within 90 days after proposal. Thus, from the date of listing a pollutant(s) under section 108, the Agency has only 12 months to propose standards, and only 3 additional months to issue final NAAQS for the pollutant(s). This tight timeframe would be particularly challenging in the case of GHGs, for which review and synthesis of an enormous body of literature would be required before a proposal could be issued. Furthermore, it is important to note that while subsequent NAAQS reviews of existing standards are required on a revolving 5-year cycle, EPA has found it challenging to meet even this extended schedule, which generally allows 9-12 months between issuance of the air quality criteria and proposal and an additional 6 months or more for issuance of final standards.

Once a new standard has been established, the CAA allows EPA to establish a deadline for states to submit designation recommendations that is no later than one year after promulgation of the new or revised NAAQS. EPA then reviews the states' recommendations, collects and assesses additional information as appropriate, and issues final designations no later than 2 years following the date EPA promulgated the new or revised NAAQS. EPA may take up to one additional year if the Administrator has insufficient information to promulgate the designations, which could push the date of final designations out to three years after promulgation of a new GHG NAAQS.

The timeline for SIP submittal and implementation of control requirements depends an area's designation status (attainment, nonattainment, unclassifiable) and whether there is only a secondary NAAQS, or both a primary and a secondary standard. These various scenarios are described above. As a first step, regardless of attainment status of level of the standard, states must submit infrastructure SIPs to EPA within 3 years of the promulgation of any new or revised NAAQS. These SIPs demonstrate that certain basic program elements (including emissions inventories, monitoring, and modeling) are properly addressed. Areas that are designated attainment would face a much shorter list of requirements, which are discussed above in the context of , Scenarios 3 and 4.

For areas designated nonattainment with a primary standard, states must submit nonattainment SIPs no more than 3 years after the effective date of designations, and must reach attainment no later than 5 years after the effective date designations. EPA can extend the attainment deadline by up to an additional 5 years – i.e., to no later than 10 years after the effective date of designations, if EPA finds additional time is needed considering the severity of nonattainment and the availability and feasibility of pollution control measures.

As noted above, the maximum 10-year horizon for attaining the primary NAAQS is ill-suited to pollutants such as GHGs with long atmospheric residence times. It is probable that, despite active control efforts, the entire U.S. would remain in nonattainment for an indefinite number of years if the level of a NAAQS were set at or below current atmospheric concentrations; whether attainment would ever be reached would depend on the timing and stringency of GHG control measures implemented on a global basis.

For areas designated nonattainment with a secondary standard only, the attainment schedule could be significantly longer. The CAA requires that state plans under a secondary standard must provide for reaching attainment as expeditiously as practicable, but there is no statutory maximum date for attainment (e.g., up to 10 years). EPA requests comment on the suitability of adapting this approach for use in the GHG context, and specifically, on the schedule that could reasonably be considered as "expeditious as practicable." We also request comment on how global emissions should be taken into consideration in this context.

EPA requests comment on whether the avenues discussed in this notice, or alternative approaches, could facilitate schedule adjustments that would better enable use of the NAAQS approach for regulating GHGs.

4. What Are Key Considerations Regarding Use of this Authority for GHGs?

a. Possible Cost and Emissions Impacts

Listing GHGs as pollutants under section 108 and setting NAAQS under section 109 would have no direct cost or emissions impacts. However, these actions would trigger further federal actions, including designations under section 107, and state or federal actions through SIPs or FIPs developed under section 110 and other provisions in title I of the CAA. Thus, the listing of GHGs as NAAQS pollutants would likely lead to the adoption of a substantial control program affecting sources across the nation.

Because establishing NAAQS for a pollutant sets in motion a broad and prescriptive implementation process that could affect a wide array of stationary and mobile sources, it is likely to entail substantial costs. The magnitude of these costs would depend, in part, on the relative reliance on technologies which are not yet suitable for commercial application or which have not yet been developed. Though this problem affects other pollutants, it is more acute in the case of GHGs. The timing and nature of controls instituted, and thus the costs, would depend to a significant extent on an area's designation status and whether EPA set only a secondary NAAQS (with a longer implementation time horizon), or a primary standard as well (with a more rapid and rigid compliance schedule, allowing less time for technological advances and efficiency improvements). The standard set and the nature of GHGs could also determine whether it is feasible to attain a NAAQS in the near-term, or how costly attainment could be over a longer term.

One important aspect of the NAAQS approach is that the standards themselves (both primary and secondary) are established without consideration of these costs. EPA requests comment on the suitability of establishing regulations to limit atmospheric concentrations of GHGs through a statutory mechanism that prohibits consideration of the costs such regulations might entail. EPA also requests comment on the extent to which various implementation mechanisms in Title I are available for addressing such costs.

As mentioned above, CAA section 108 requires EPA to issue information on air pollution control techniques at the same time it issues air quality criteria. This would include information on the cost of installation and operation, energy requirements, emission reduction benefits, and environmental impacts. Generally, the Agency fulfills this obligation at the time a standard is issued; as required under Executive Order 12866, EPA must issue an RIA for major rulemaking actions. A NAAQS RIA provides an illustrative analysis of control options available to reduce emissions and ambient concentrations of the regulated pollutant(s); evaluates the costs of these controls; and estimates the human health and environmental benefits likely to accrue from the improved air quality resulting from the standards.

As required by EO 12866 and guidance from OMB, the analysis generally compares control options and estimated costs and benefits of multiple, specific standard options under consideration. While EPA recognizes the cost estimates for future GHG control technologies would potentially place more reliance on yet-to-be-developed options, the precedent exists for consideration of future, unknown controls. EPA requests comment on whether there are important distinctions between GHGs and previously regulated criteria pollutants that would make it appropriate in the case of a new NAAQS for GHG(s) to issue a separate air pollution control techniques document earlier in the process, specifically in conjunction with the air quality criteria as required by section 108, or whether such information is more useful if tailored to specific standard options under consideration, as in the RIA.

b. Technology Development and Leakage

Two of the policy design considerations noted in section III.F.1 include the potential to promote technology development and to address potential concerns about shifting emissions to other countries. The NAAQS establish standards based on ambient concentrations that must be attained and maintained everywhere, and are implemented through SIPs that establish emissions budgets consistent with meeting the standards. The limited emissions budget encourages state and local areas and affected sources to work together to identify least-cost emissions controls to meet their SIP obligations and reduce ambient concentrations of the regulated pollutant(s). The NAAQS requirements help create market demand for technologies that can assist in meeting air quality standards at the least cost. As discussed in Section III.C of this notice, this process has encouraged significant technological innovation. EPA requests comment on the extent to which the NAAQS can be an effective mechanism for encouraging technological innovation and development of least-cost controls for GHG emissions.

The 10-year maximum timeline for attaining a primary NAAQS would allow some time for development and deployment of emerging technologies, but longer timelines available under other forms of the NAAQS would provide greater flexibility to provide continuous incentives over a longer time period for major technology advances, and more time to deploy new technologies that are developed. EPA requests comment on the extent to which a GHG NAAQS could reasonably be expected to advance new control technologies, and on what timeframe.

With respect to the leakage issue, establishing a primary NAAQS could lead to high costs among affected industries unless a viable approach is identified to limit the control burden on U.S. sources. Because the standards themselves are set without consideration of cost or availability of control technologies, and because states would be required to adopt a plan to attain a primary standard within 10 years of designation, the NAAQS approach might offer less flexibility to delay emissions reductions in the absence of effective control technologies or when costs are prohibitive. This consideration may be particularly relevant in the case of GHGs, where highly efficient control technologies or mitigation options are currently limited, and where critical new control strategies, such as carbon capture and storage, are still in the early stages of development. In these instances, industries that are unable to locate cost-effective control strategies may consider relocating to non-regulated locations, resulting in significant emissions leakage.

We request comment on the cost-effectiveness of utilizing a NAAQS approach to regulating GHGs, and on the extent to which this approach might be expected to result in emissions leakage, especially as compared to other potential regulatory approaches outlined in this notice.

c. Summary of Opportunities and Challenges Afforded by NAAQS Pathway

Regulating GHGs through a NAAQS offers certain opportunities; however, there are also significant technological, legal and program design challenges that would tend to limit the appropriateness of the NAAQS program.

NAAQS are based purely on preventing adverse health and environmental impacts, rather than on considerations of cost, feasibility, or availability of technology.

Our expectation is that the NAAQS approach would establish a goal tied to actual ambient concentrations of GHGs. A NAAQS would call for assessment of potential control strategies for a broad array of sources, rather than focusing only on emissions reductions from a specified (but potentially limited) list of sources. The NAAQS approach would allow for some flexibility in the design of control strategies and requirements, including the possibility of a cap-and-trade approach, and might spur significant technological innovation. It would provide a mechanism for reducing GHG emissions from current sources and limiting the growth of emissions from new sources. If the facts supported adopting only a secondary standard, this would somewhat reduce the specific obligations on states, and would allow a suitably extended timeline for achieving the emissions reductions necessary to stabilize and then reduce ambient GHG concentrations.

Though such an approach has the potential to be effective in reducing emissions, there would be a number of obstacles to overcome. Chief among these is that if worldwide (non-U.S.) emissons were to continue increasing, global concentrations of GHGs would continue to increase despite U.S. emission control efforts, and the NAAQS would be unachievable (depending on the level of the standards) even if U.S. emissions were reduced to zero. Unless viable legal approaches could be identified for limiting the control burden on U.S. sources, such as by defining a U.S. share of the emissions reductions needed to attain a NAAQS, the NAAQS approach would result in an expensive program. It would not achieve the adopted GHG NAAQS due to foreign emissions growth, although U.S. emissions reductions would be achieved. If the result of a NAAQS were stringent unilateral controls for vulnerable industries, this would encourage emissions leakage in the absence of comparable control efforts abroad.

Especially if the Agency were to set a primary as well as a secondary standard, a NAAQS would trigger a relatively rigid implementation apparatus, limiting the Agency's flexibility to target cost-effective emissions reductions and to shift the burden of control requirements among different industries based on the availability of new technological approaches. The lack of flexibility allowed under the CAA for many of the NAAQS implementation requirements – especially those affecting areas designated nonattainment with a primary standard --makes them difficult to adapt effectively for application in the GHG context. For example, it would be challenging to apply requirements for transportation conformity under a GHG NAAQS, or for states to develop attainment demonstration SIPs As discussed in section IV.E, a nonattainment new source review program requiring for GHGs would dramatically expand the scope of the preconstruction permitting program to include smaller sources and new types of sources such as apartment buildings with natural gas heat, unless EPA were successful in applying legal theories that justify deviating from statutory language. This would pose substantial administrative feasibility and cost issues. While implementation of an attainment-level NAAQS would involve fewer specific requirements, this avenue would only apply if the standard set by EPA under section 109 resulted in attainment designations. Section 109 calls for standards to be set based on science-based criteria, which exclude consideration of the cost or efficiency of the implementation requirements in determining the level of the standard.

We note that while the NAAQS implementation system is state-based, legislative proposals have focused on establishing federally administered national cap-and-trade strategies to address the global climate problem.

In closing, we request comment on our assessment of NAAQS approaches, and on how the NAAQS approach compares to other potential CAA approaches in light of the policy principles enunciated in section III.F.1.

5. Possible Implications for Other CAA Provisions

Listing a pollutant under section 108(a)(1) would preclude listing under section 112 or regulation under section 111(d), but would not preclude listing and regulation under section 111(a)-(c) New Source Performance Standards (NSPS) provisions as described below. Similarly, regulation of GHGs under section 111(a) – (c) NSPS provisions, as discussed further in other sections of today's notice, would not preclude regulation of those pollutants through a NAAQS, although controls implemented through these provisions might influence the Agency's perspective on the appropriateness of establishing air quality criteria for GHGs. EPA requests comment on the extent to which regulatory action under section 111 could be considered in the context of exercising authority under section 108 relevant to GHGs.

B. Standards of Performance for New and Existing Sources

CAA section 111 provides EPA with authority to set national performance standards for stationary sources. There are two alternative pathways for using section 111 to regulate GHGs -- as part of an implementation program for a GHG NAAQS or as a freestanding program.

- In the event of a GHG NAAQS, section 111 authorizes EPA to set emissions performance standards for new and modified sources but not for unmodified existing sources.
- In the absence of a GHG NAAQS, section 111 offers the potential for an independent, comprehensive program for regulating most stationary sources of GHGs, except to the extent GHG emissions are regulated under section 112

Section 111 provides for consideration of cost, and allows substantial discretion regarding the types and size of sources regulated. As with most other CAA authorities, however, establishment of a section 111 standard for any source category of GHGs would trigger preconstruction permitting requirements for all types of GHG major sources under the PSD program.

The Stationary Source TSD for this ANPR identifies some specific industry sectors that EPA has evaluated for their emissions of multiple pollutants, including GHGs. EPA requests comment on this analysis. In addition, EPA requests comment on GHG emissions from these and all other categories and subcategories that have been subject to section 111 standards and on the relative costs that could be associated with employing certain identified control technology or practices affecting GHG emissions, including any positive or negative impacts on the emissions of traditional pollutants.

1. What Does Section 111 Require?

Section 111 establishes two distinct mechanisms for controlling emissions of air pollutants from stationary sources. Section 111(b) provides authority for EPA to promulgate New Source Performance Standards (NSPS) which may be issued regardless of whether there is a NAAQS for the pollutant being regulated, but apply only to new and modified sources. Once EPA has elected to set an NSPS for new and modified sources in a given source category, section 111(d) calls for regulation of existing sources with certain exceptions explained below. Taken together, the section 111 provisions could allow significant flexibility in regulation that may not be available under other CAA Title I provisions.

a. Section 111(b) New Source Performance Standards

Section 111(b) of the CAA requires EPA to establish emission standards for any category of new and modified stationary sources that the Administrator, in his judgment, finds "causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare." EPA has previously made endangerment findings under this section for more than 60 stationary source categories and subcategories that are now subject to NSPS.[239] An endangerment finding would be a prerequisite for listing additional source categories under section 111(b), but is not required to regulate GHGs from source categories that have already been listed.

[239] EPA has developed NSPS for more than 70 source categories and subcategories. However, endangerment findings apply to the categories as a whole, while subcategories within them have been established for purposes of creating standards that distinguish among sizes, types, and classes of sources.

For listed source categories, EPA must establish "standards of performance" that apply to sources that are constructed, modified or reconstructed after EPA proposes the NSPS for the relevant source category.[240] However, EPA has significant discretion to define the source categories, determine the pollutants for which standards should be developed, identify the facilities within each source category to be covered, and set the level of the standards. In addition, EPA believes that the NSPS program is flexible enough to allow the use of certain market-oriented mechanisms to regulate emissions, as discussed below.

As implemented over many years by EPA, the NSPS program has established standards that do not necessarily set emission limits for all pollutants or even all regulated pollutants emitted by sources within the relevant source category. Rather, the NSPS generally focus on specific pollutants of concern for a particular source category. Air pollutants currently regulated through section 111(b) include the criteria pollutants listed under section 108 and certain additional pollutants. These additional pollutants are acid mist, fluorides, hydrogen sulfide in acid gas, total reduced sulfur, and landfill gas. EPA has discretion to revise an existing NSPS to add standards for pollutants not currently regulated for that source category, but has interpreted the section to not require such a result when an NSPS is reviewed pursuant to section 111(b)(1)(B). That section requires EPA to review and, if appropriate, revised NSPS every eight years unless the Agency

[240] Specific statutory and regulatory provisions define what constitutes a modification or reconstruction of a facility. 40 CFR 60.14 provides that an existing facility is modified, and therefore subject to an NSPS, if it undergoes "any physical change in the method of operation . . . which increases the amount of any air pollutant emitted by such source or which results in the emission of any air pollutant not previously emitted." 40 CFR 60.15, in turn, provides that a facility is reconstructed if components are replaced at an existing facility to such an extent that the capital cost of the new equipment/components exceed 50 percent of what is believed to be the cost of a completely new facility.

determines that such review in not appropriate in light of readily available information on the efficacy of the standard.

Further, in contrast to other provisions in the CAA which require regulation of all sources above specific size thresholds, section 111 gives EPA significant discretion to identify the facilities within a source category that should be regulated. To define the affected facilities, EPA can use size thresholds for regulation and create subcategories based on source type, class or size. Emission limits also may be established either for equipment within a facility or for an entire facility.

EPA also has significant discretion to determine the appropriate level for the standards. Section 111(a)(1) provides that NSPS are to "reflect the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated." This level of control is commonly referred to as best demonstrated technology (BDT). In determining BDT, we typically conduct a technology review that identifies what emission reduction systems exist and how much they reduce air pollution in practice. This allows us to identify potential emission limits. Next, we evaluate each limit in conjunction with costs, secondary air benefits (or disbenefits) resulting from energy requirements, and non-air quality impacts such as solid waste generation. The resultant standard is commonly a numerical emissions limit, expressed as a performance level (i.e. a rate-based standard). While such standards are based on the effectiveness of one or more specific technological systems of emissions control, unless certain conditions are met, EPA may not prescribe a particular technological system that must be used to comply with a NSPS. Rather, sources remain free to elect whatever combination of measures will achieve equivalent or greater control of emissions.

It is important to note that under section 111, the systems on which a standard is based need only be "adequately demonstrated" in EPA's view such that it would be reasonable to apply them to the regulated category. The systems, and corresponding emission rates, need not be actually in use or achieved in practice at potentially regulated sources or even at a commercial scale. Further, EPA believes that if a technology is "adequately demonstrated" for use at a date in the future, EPA could establish a future-year standard based on that technology. This would allow EPA to develop two- or multi-phased standards with more stringent limits in future years that take into account and promote the development of technology.

Costs are also considered in evaluating the appropriate standard of performance for each category or subcategory. We generally compare control options and estimated costs and emission impacts of multiple, specific emission standard options under consideration. As part of this analysis, we consider numerous factors relating to the potential cost of the regulation, including industry organization and market structure; control options available to reduce emissions of the regulated pollutant(s); and costs of these controls. Frequently, much of this information is presented in the Regulatory Impact Analysis (RIA) that is required for all major rulemaking actions.

b. Section 111(d) Emissions Guidelines for Existing Sources

Section 111(d) requires regulation of existing sources in specific circumstances. Specifically, where EPA establishes a NSPS for a pollutant, a section 111(d) standard is required for existing sources in the regulated source category except in two circumstances. First, section 111(d) prohibits regulation of a NAAQS pollutant under that section. Second, "where a source category is being regulated under section 112, a section 111(d) standard of performance cannot be established to address any HAP listed under 112(b) that may be emitted from that particular source category."[241]

Section 111(d) also uses a different regulatory mechanism to regulate existing sources than section 111(b) uses for new and modified sources in a source category. Instead of giving EPA direct authority to set national standards applicable to existing sources in the source category, section 111(d) provides that EPA shall establish a procedure for states to issue performance standards for existing sources in that source category. Under the 111(d) mechanism, EPA first develops regulations known as "emission guidelines." These may be issued at the same time or after an NSPS for the source category is promulgated. Although called "guidelines," they establish binding requirements that states are required to address when they develop plans to regulate the existing sources in their jurisdictions. These state plans are similar to state implementation plans and must be submitted to EPA for approval. Historically, EPA has issued model standards for existing sources that could then be adopted by states. Under this approach, creating an interstate trading system would require adoption of compatible state rules promoted by EPA rules and guidance. In the event that a state does not adopt and submit a plan, EPA has authority to then issue a federal plan covering affected sources.

[241] See 70 FR 15994, 16029-32 (Mar. 29, 2005).

Section 111(d) guidelines, like NSPS standards, must reflect the emission reduction achievable through the application of BDT. However, both the statute and EPA's regulations implementing section 111(d) recognize that existing sources may not always have the capability to achieve the same levels of control at reasonable cost as new sources. The statute and EPA's regulations in 40 CFR 60.24 permit states and EPA to set less stringent standards or longer compliance schedules for existing sources where warranted considering cost of control; useful life of the facilities; location or process design at a particular facility; physical impossibility of installing necessary control equipment; or other factors making less stringent limits or longer compliance schedules appropriate.

2. What Sources could be Affected?

Section 111 has been used to regulate emissions of traditional and nontraditional air pollutants from a broad spectrum of stationary source categories. EPA has already promulgated NSPS for more than 70 source categories and subcategoriesand we could add GHG emission standards, as appropriate, to the standards for existing source categories.[242] EPA has begun a review of the existing NSPS source categories to determine whether it would be appropriate to regulate GHG emissions from sources in each category. In addition, EPA is in the process of responding to a remand from the

[242] Some of the existing source categories are very broad, comprising an entire industrial process such as steel making, while others are narrowly defined as a single piece of equipment within a broader production process. Examples of source categories subject to NSPS are fossil fuel-fired boilers, incinerators, sulfuric acid plants, petroleum refineries, lead smelters, and equipment leaks of VOCs in the synthetic organic chemicals manufacturing industry. A complete list of the NSPS source categories is found at 40 CFR Part 60.

D.C. Circuit requiring it to consider whether to add standards for GHGs to the NSPS for utility boilers, and EPA has received suggestions that it would be appropriate to add such standards to the NSPS for Portland cement kilns.[243]

To determine whether regulation of GHGs is appropriate for existing categories, we must evaluate whether it is reasonable to do so given the magnitude of emissions and availability of controls, considering the costs of control. Decisions in this regard could be influenced by several factors, including the magnitude of the GHG emissions from a source category; the potency of the particular GHG emitted; whether emissions are continuous, seasonal or intermittent; the availability of information regarding the category's GHG emissions; and whether regulating GHG emissions from the source category would be beneficial. EPA requests comment on the extent to which these factors should, if at all, influence EPA's decisions whether to add standards to existing NSPS and what additional factors should be taken into consideration. EPA also requests comment on which of the previously regulated categories might be appropriate for GHG regulation and on the information on which such judgments might be based.

To inform the public of EPA's analytical work to date, we have provided descriptions of key industrial sectors, their GHG emissions, and information that we have collected to date on GHG control options for those sectors in the Stationary Source TSD

[243] The NSPS for Petroleum Refineries were recently amended, resulting in the promulgation of new Subpart Ja. These performance standards include emission limitations and work practice standards for fluid catalytic cracking units, fluid coking units, delayed coking units, fuel gas combustion devices, and sulfur recovery plants. As such, they regulate criteria pollutant emissions from the processes that are also responsible for most of the refinery GHG emissions. During the public comment period for Subpart Ja, we received several comments in favor of developing new source performance standards to address GHG emissions from refineries. However, we declined to adopt standards for GHG emissions in that rulemaking, in part because while doing so was within our discretion, we believed that it was important to fully consider the implications for programs under other parts of the CAA before electing to regulate GHG under section 111. This is a fundamental purpose for today's notice and request for comments.

in the docket for today's notice. It is important to note that, as described further in the technical support materials, many near-term technologies or techniques for reducing GHG, e.g., energy efficiency or process efficiency improvements, are relatively cost effective and achieve modest emission reductions when compared with the potential of some add-on control techniques. Other controls may become available in the future whose costs and emission reduction effectiveness may differ substantially from what is discussed here today. The Stationary Source TSD also discusses various mechanisms, such as cap-and-trade programs or emissions averaging approaches across facilities or industries, that can help reduce costs of reducing emissions. EPA requests comment on the availability and extent of its legal authority for such mechanisms.

In addition to regulating GHGs from previously listed source categories, section 111 provides discretionary authority to list new source categories, or reformulate listed source categories, for purposes of regulating of GHG emissions. For example, such categories could include sources of emissions covered by existing NSPS source categories as well as sources not currently covered by any NSPS. One option available to EPA is the reorganization of source categories for purposes of GHG regulation. In creating new categories to be used for regulation of GHGs, EPA could consider factors unique to GHG emissions. For example, EPA could take into account concerns about emissions leakage (discussed in section III.F.5 of this notice), and structure categories to minimize opportunities for shifting emissions to other source categories. EPA could also explore how the rearrangement of source categories could facilitate netting arrangements through which a more broadly defined "source" could avoid triggering an GHG NSPS by off-setting its increased GHG emissions.[244] In addition, EPA could structure categories to take into account possible reductions from improvements at non-emitting parts of the plants, for example, by creating source categories that cover all equipment at particular plants, instead of using categories that cover only specific types of equipment at a plant. EPA invites comment on whether such rearrangement would be appropriate and what type of rearrangement would be desirable. We also solicit information on how rearrangement could facilitate netting and how we might structure such netting.

An alternative, or complementary, scenario would be to create larger "super-categories" covering major groupings of stationary sources of GHG emissions. For example, it might be possible to create process-based categories (i.e. all sources emitting CO_2 through a stack as a result of combustion processes) or vertically integrated categories which take more of a life-cycle approach to the control of GHG emissions and reduce the possibility of leakage of GHG reductions to other parts of the economy or other geographic regions.[245] The creation of such "super-categories" might provide additional opportunities for the development of innovative control mechanisms such as cap-and-trade programs covering multiple industry sectors. In light of these considerations, EPA requests comment on whether the creation of such "super categories" would be appropriate and what categories would be most useful for regulating GHGs.

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[244] We recognize that the Court in Asarco Inc. v. EPA, 578 F.2d 326 (D.C. Cir. 1978) struck down an NSPS provision that allowed netting. The provision at issue there, however, permitted netting *between sources,* not within a source. See Alabama Power v. EPA, 636 F.2d 323, 401-02 (D.C. Cir. 1980).

[245] For instance, a "super-category" could be created encompassing all aspects of the production, processing, and consumption of petroleum fuels, or to regulate the production and consumption of fossil fuels for heat and power, addressing all aspects of emissions-producing activity within a sector, including fuel production, consumption, and energy conservation.

Under either option, EPA possesses authority to distinguish among classes, types and sizes of sources within existing categories for purposes of regulating GHG emissions. For example, we have at times distinguished between new and modified/reconstructed sources when setting the standards. This may be appropriate, for instance, when a particular new technology may readily be incorporated into a new installation, but it may be technically infeasible or unreasonably costly to retrofit this technology to an existing facility undergoing modification or reconstruction. Alternatively, we have distinguished among sources within a category, for instance fossil fuel-fired boilers, for which we have subcategorized on the basis of fuel types (e.g., coal, oil, natural gas). EPA requests comment on what considerations are relevant to determining whether it is appropriate and reasonable to establish subcategories for regulation under section 111.

3. What Are Possible Key Milestones and Implementation Timelines?

a. Priority Setting Among Source Categories

If EPA were to pursue section 111 regulation of GHGs, timetables for regulation would depend upon how EPA prioritized among source categories to determine which categories should be regulated first. In the near term, it may be possible to address GHGs under section 111 in a limited fashion by establishing control requirements for new and existing sources in some number of existing source categories, while information is developed on other source categories. Actions under other portions of the CAA may involve longer lead times to develop and implement, so that standards under section 111 for certain source categories could provide for emission reductions in the interim. We have begun to examine source categories subject to existing NSPS and other standards to consider how we might determine priorities among them for review and revisions, and whether GHGs could be addressed for specific sectors in a more coordinated. multi-pollutant fashion. EPA requests comment on the availability of its legal authority, if any, to prioritize among source categories in the event that regulation under section 111 was pursued.

Under a “prioritization” approach, EPA could seek to revise standards earliest for those categories offering the greatest potential for significant reductions in the emissions of covered pollutants, and either deferring action or determining that no further action is necessary or appropriate at this time for other categories. This conclusion could be based, for example, on the lack of significant improvements in technology since the last NSPS review or the fact that no new sources are considered to be likely in the foreseeable future.

Another possibility might be to schedule and structure the review and revision of standards for source categories to account for the facts that, in addition to the need to address GHG emissions, they may be subject to multiple standards for different pollutants under several sections of the CAA. Such standards may often be subject currently to different review timetables resulting from when these standards were last established or revised. In addition, as discussed in section III.D of today’s notice, they may have the potential for positive or negative interactions with one another and with opportunities for the control of GHG emissions.

Still another approach might consider the impacts of future reduction opportunities or enacted legislation so that standards under section 111 might focus initially on source categories for which near-term benefits might result largely from efficiency improvements which do not result in “stranded capital,” or investment in systems that will be superseded by more effective systems that we determine will be available at some specific future date. Alternatively, standards could focus on those sectors of the economy which will not likely be subject to controls being addressed in enacted legislation.

We request comment on EPA’s available legal authority, if any, to defer action with respect to any “class” of section 111 source categories or subcategories as well as how and under what circumstances EPA could also consider such approaches to the identification of source categories for standards to address GHGs. Assuming the existence of adequate authority, what, if any, additional criteria should be considered in our priority-setting analysis efforts? In considering such sector- or multi-pollutant-based approaches, we further request comment on the extent to which we could establish new or revised source categories which better accommodate these approaches, or whether we are bound by existing source categories and their definitions.

b. Timetables for Promulgation and Implementation

In our experience, collecting and analyzing information regarding available control technologies, resulting emission reductions, and cost effectiveness can take up to several years for a source category. However, this time period can be shortened to 1 1/2 to 2 years when information is readily available or is presented to the Agency in a form that facilitates efficient consideration. With respect to GHGs, there has been significant effort devoted to identifying and evaluating ways to reduce emissions within sectors such as the electricity generating industry, and we are aware of the potential for GHG reductions through energy efficiency and other means within other industries. However, for many others, technologies for reducing GHG emissions have not yet been identified or evaluated by EPA. EPA requests comment on whether and how the availability of current information should be considered when considering regulation under section 111.

As is the case with traditional pollutants, any new or revised NSPS for new and modified sources of GHGs under section 111(b) would be developed through a notice and comment rulemaking process and would be effective upon promulgation. As noted previously, EPA is also required to review, and if appropriate revise, existing NSPS every 8 years unless the Administrator determines that "such review is not appropriate in light of readily available information on the efficacy of such standard." Standards for pollutants not regulated by the existing NSPS may be added concurrent with the 8-year review, but such additions are not part of that review process.

Any section 111(d) emission guidelines associated with the revised NSPS standards would be promulgated either along with or after the NSPS. States are generally required to submit the required state plans containing the standards of performance applicable to existing sources in their jurisdictions with 9 months of EPA's promulgation of the guidelines.

In the case of existing sources regulated under section 111(d), affected sources are typically provided up to 3 years to comply with any resulting requirements; however, states have flexibility to provide longer or shorter compliance timeframes based on a number of source-specific factors. In addition, where we determine that a technology has been adequately demonstrated to be available for use by some particular future date, we believe it is possible to establish timeframes for compliance that reflect this finding.[246]

No explicit 8-year review requirement exists with regard to section 111(d) standards for existing sources. Nonetheless, it also may be appropriate to require existing source plans to periodically revise their control strategies to reflect changes in available technologies and standards over time, particularly where the existing limitations were based on more limited controls at the time they were established. EPA requests comment on its authority and the advisability of such periodic updating with respect to the possible control of GHG.

The CAA and EPA's regulations implementing section 111(d) permit states to consider a number of factors when determining the level of stringency of controls, but do not establish a bright line test when stricter requirements for existing sources are warranted. Many of these sources may also be subject to requirements for the control of other non-section 111(d) pollutants as part of implementation plans to attain and maintain NAAQS for one or more pollutants, and in some cases, these provisions may result in more stringent coincidental control of section 111(d) pollutants. We request comment on how and when we should evaluate, review, and revise as appropriate any section 111(d) standards that might be established in the future for GHGs.

4. What Are the Key Considerations Regarding Use of This Authority to Regulate GHGs?

[246] See Portland Cement Association v. EPA, 486 F.2d 275 (D.C. Cir. 1973).

a. Key Attributes and Limitations of Section 111

As noted above, section 111 possesses certain flexible attributes that may be useful in tailoring emissions standards to address GHG emissions. Yet, regulation under this section also has important limitations. This section of today's notice briefly summarizes these attributes and limitations. We request comment on how these attributes and limitations relate to the policy design considerations set forth in section III.F.1.

Program scope: Section 111 provides EPA with authority to regulate GHG emissions from stationary source categories, but does not require EPA to regulate GHGs emitted by all source categories or even all listed source categories. EPA has flexibility to identify the source categories for which it is appropriate to establish GHG limits. For example, EPA could decide to set GHG limits for those source categories with the largest GHG emissions and reduction opportunities. EPA could postpone or decline to set GHG limits for source categories for which emissions contributions may be small or for which no effective means of reducing emissions exist, currently or within the reasonably foreseeable future. EPA also could consider traditional air pollutants as well as GHGs in setting its overall priorities for the NSPS program.

Source size: Section 111 does not require regulation of all sources above a certain size. Instead, EPA has discretion to use rational emission thresholds to identify which facilities within a source category are covered by NSPS standards.

Consideration of cost: Section 111 explicitly directs EPA to take "into account the cost of achieving" emission reductions, as well as other nonair quality, health and environmental impact and energy requirements." This gives EPA significant flexibility to determine of appropriate levels of control, and can be an important source of distinctions between requirements for new sources and those for modified or reconstructed sources.

Potential for emissions trading: As EPA has interpreted the NSPS requirements in the past with respect to certain air pollutants, we believe that the NSPS program could use emissions trading, including cap-and-trade programs and rate-based regulations that allow emissions trading, to achieve GHG emission reductions. EPA believes such programs are consistent with the statutory requirements because they satisfy the three substantive components of the section 111(a)(1) definition of "standard of performance" – (1) a standard for emissions of air pollutants; that (2) reflects that degree of emission limitation available"; and (3) "constitutes the best system of emission reduction." A cap-and-trade program can constitute a "standard for emissions of air pollutants" because it is a system created by EPA for control of emissions. The use of emissions budgets does not make the system less of a "standard" since the budgets must be met regardless of the methodology used to allocate allowances to specific sources. Further, any such system would be based on our assessment of the overall degree of emission reduction available for the source category and our analysis of the available systems of emission reductions. EPA could select a market-oriented mechanism as the "standard of performance" if these analyses (including cost analyses) indicate that the system would "reflect the degree of emission limitation achievable" and "constitute the best system of emission reduction."

EPA also believes that trading among new and existing sources could be permitted, and could offer, at least in some cases, cost efficiencies.[247] EPA also believes that because of the potential cost savings, it might be possible for the Agency to consider deeper reductions through a cap-and-trade program that allowed trading among sources in various source categories relative to other systems of emission reduction. We request comment on the extent of EPA's available legal authority in this area as well as the attributes such a program must possess to qualify as a standard of performance under section 111.

Potential for declining performance standards: EPA believes that section 111 authority may be used to set both single-phase performance standards based upon current technology and to set two-phased or multi-phased standards with more stringent limits in future years. Future-year limits may permissibly be based on technologies that, at the time of the rulemaking, we find adequately demonstrated to be available for use at some specified future date. Alternatively, it may be possible to establish a goal based on future availability of a technology and to revise the standard to reflect technological advancements at appropriate intervals, such as the 8-year review cycles. We believe these concepts could be applied to standards for new and modified sources, as well as to standards for existing sources under section 111(d). In addition, this concept could be coupled with emissions trading.

[247] In the Clean Air Mercury Rule we concluded that new sources needed to comply with a unit specific control requirement in addition to participating in the trading program. We solicit comment on whether section 111 requires such controls for new sources or if it would be sufficient for them to participate in a trading program or other market based mechanism without this restriction. While not ensuring an equally stringent level of control at each new source, the latter approach would be expected to achieve the same total emissions reductions at a lower overall compliance cost.

We recognize that various legal issues and questions concerning legal authority may be involved in setting standards based on technology only adequately demonstrated for use at a future date. For example, there might be greater uncertainty regarding the cost of technology for such standards than for standards based only on technology that is already commercially demonstrated at the time of promulgation. In the Clean Air Mercury Rule (CAMR), which was vacated by the D.C. Circuit on other grounds, EPA interpreted section 111 to allow a two-phased "standard of performance" to reduce mercury emissions from existing sources. The compliance date for the more stringent second phase was 2018. EPA believed that it had greater flexibility to set such a standard for existing sources under section 111(d) because these standards, in contrast to section 111(b) standards for new sources, are not subject to the requirements of section 111(e). Section 111(e) makes unlawful to operate any new source in violation of a standard of performance after its effective date. EPA requests comment on this interpretation. We also request comment on the circumstances under which the requirements of section 111(e) would be satisfied by a standard requiring compliance with the initial requirements of a multi-phase standard. More generally, EPA seeks comment on its legal authority in this matter as well as the legal and factual conditions that must be satisfied to support a multi-phase standard with future-year standards based on technology adequately demonstrated for use by that future date. EPA also seeks comment on how far into the future multi-phase standards could extend and the degree of certainty with which EPA must make its determinations of availability for future use, considering the section 111 standard setting language.

Technology development: Section 111 also contains a waiver provision that can be used to encourage the development of innovative technologies, as described below.

Standards tied to available technology: The fact that section 111 requirements are based upon a demonstration of the availability of control technology could limit the amount of reductions achievable through section 111 regulations to demonstrably feasible and cost-effective levels. If a given level of overall emission reduction is determined to be necessary and that level exceeds what is currently demonstrated to be feasible now or by some future date, then section 111 may not provide adequate authority by itself to achieve needed reductions. Although section 111 provides certain opportunities and incentives for technology development, this feature may make it more difficult to set "stretch goals" without other companion mechanisms.

In light of these considerations, we request comment on whether and to what extent section 111 provides an appropriate means for regulating GHG emissions.

b. Additional Considerations

We also request comment on the questions presented below which relate to the manner in which EPA could or should exercise its authority under this section to regulate GHGs.

i. What regulatory mechanisms are available?

As noted above, NSPS standards and 111(d) emission guidelines most commonly establish numerical emission standards expressed as a performance level. Such rate-based limits, however, are not the only mechanisms that could be used to regulate GHGs.

Efficiency Standards: We believe that most reductions in stationary GHG emissions may occur initially as the result of increased energy efficiency, process efficiency improvements, recovery and beneficial use of process gases, and certain raw material and product changes that could reduce inputs of carbon or other GHG-generating materials. Such emission reductions may range in the near term (e.g., 5-10 years) from 1 to 10%. Thus, it could be possible to utilize NSPS standards to ensure reductions from efficiency improvements are obtained. For such standards to be effective, they likely would generally need to apply to the entire facility, not just specific equipment at the facility. EPA requests comment on the availability of its legal authority in this area and whether and when it might be appropriate to establish efficiency standards for source categories as a way of reducing GHG emissions.

Plant-wide standards: EPA also believes there may be benefits to developing plant-wide or company-wide standards for GHG emissions. Section 111, however, requires each affected facility to comply with the standard. EPA believes that it could redefine the affected facility for certain categories, for purposes of GHG regulation only, to include an entire plant. EPA also requests comment on whether it would be consistent with the statutory requirements to establish company-wide limits.

Work practice standards: In some circumstances, it may not be possible to identify a specific performance level for sources in a particular category; however, section 111(h) permits promulgation of design, equipment, work practice, or operational standards but allows such standards to be established only in specific circumstances. Specifically, it provides that where we determine ”that (A) a pollutant or pollutants cannot be emitted through a conveyance designed and constructed to emit or capture such pollutant, or that any requirement for, or use of, such a conveyance would be inconsistent with any Federal, State, or local law, or (B) the application of measurement methodology to a particular class of sources is not practicable due to technological or economic limitations,” we may establish a “design, equipment, work practice, or operational standard, or combination thereof, which reflects the best technological system of continuous mission reduction which . . . has been adequately demonstrated.” EPA requests comment on the circumstances under which the section 111(h) criteria would be satisfied and when, and for which source categories, work practice standards could be appropriate standards to control GHGs.

Market-oriented regulatory mechanisms: As mentioned above, EPA believes that market-oriented regulatory approaches including emissions trading are worthy of consideration for applying NSPS to GHG emissions. Several market-oriented regulatory mechanisms are discussed in section VII.G of today’s notice. EPA requests comment on which of these mechanisms are consistent with the section 111 definition of a “standard of performance.”

ii. Request for comment on section 111 regulatory approaches

This notice and the Stationary Source TSD describe possible approaches for using section 111 to reduce GHG emissions, in general and in regard to particular source categories. We request comment on the following specific questions regarding potential regulatory approaches under section 111:

- What are the overall advantages and disadvantages of the regulatory approaches discussed above, in light of the policy design considerations in section III.F.1? Please describe in detail any approaches not discussed in today's notice that you think we should consider.
- What are the industry-specific advantages and disadvantages of the regulatory approaches discussed above and in the TSD?

In developing section 111 standards for a particular source category (e.g., refineries, cement plants, industrial commercial boilers, electric generating plants, etc.) we are requesting source category-specific comments on the following additional issues:

- What data are available, or would need to be collected, to support the development of performance standards, either by process, subcategory, or for the facility?
- Should the standards be different for new and existing sources, either in terms of the systems for emission reductions on which they should be based and/or on the regulatory structure and implementing mechanisms for such standards?
- To what extent, if any, should the standards be technology-forcing for existing sources?
- Should the standards require additional reductions over time? To what extent would such reductions be consistent with the authority and purpose of section 111, and how should they be designed and carried out to ensure consistency?

iii. What reductions could be achieved from efficiency improvements at existing sources?

Recognizing that existing sources do not have as much flexibility in the levels of control that may realistically be achieved at a new source, a section 111(d) standard regulating GHG from existing sources would at this time most likely focus on currently available measures to increase the energy efficiency at the facility, thereby reducing GHG emissions. Examples of typical measures that promote energy efficiency include the use of cleaner fuels and equipment replacement or process improvements which reduce energy consumption. How well a measure, or combination of measures, will reduce GHG emissions at an individual facility will vary. A review of available literature suggests a range of improvements for various industry sectors that may be achievable through energy and process efficiency improvements, and some representative examples are summarized below. This information is illustrative, and does not represent any final technical determination by the agency as to what emission reduction requirements might be appropriate to require from the source categories discussed below.

For example, reductions in emissions of GHG from cement plants would most likely occur from fuel efficiency and electric energy efficiency measures as well as raw material and product changes that reduce the amount of CO_2 generated per ton of cement produced. There are numerous efficiency measures generally accepted by much of the U.S. industry, and many of these measures have been adopted in recent cement plant improvements. Such measures may directly reduce GHG emissions by cement plants, or they may indirectly reduce GHG emissions at sources of power generation due to reduced electrical energy requirements. The range of effectiveness of the individual measures in reducing GHG is from less than 1% to 10%.[248] Benchmarking and other studies have demonstrated a technical potential for up to 40% improvement in energy efficiency for a new cement plant using the most efficient technologies compared to older plants using wet kilns.

A number of opportunities may exist within refineries to increase energy efficiency by optimizing utilities, fired heaters, heat exchangers, motors, and process designs. Competitive benchmarking data indicate that most petroleum refineries can economically improve energy efficiency by 10 to 20%.[249] Therefore, we would expect that a new refinery could be designed to be at least 20% more efficient than an existing one.

In the case of industrial boilers, measures applied to individual facilities could result in energy savings and GHG reductions on the order of 1% to 10%. Replacing an existing boiler with a combined heat and power plant could improve the energy efficiently of an existing plant by 10% to 33%.

Existing coal-fired power plants can reduce their fuel consumption (reduce heat rate) and reduce CO_2 emissions by performing well known modifications and upgrades to plant systems. Heat rate reductions of up to 10% may be feasible through various efficiency improvements at individual coal units, depending on site specific conditions. Because of plant age and other physical limitations, the potential average heat rate reduction for the coal fleet would likely not exceed about 5%. The existing fleet operates at an average net efficiency of about 33%. If the corresponding coal fleet average net heat

[248] U.S. EPA (2008), Air Pollution Controls and Efficiency Improvement Measures for Cement Kiln. Final Report.
[249] Energy Efficiency Improvement and Cost Saving Opportunities for Petroleum Refineries, LBNL, 2005

rate were reduced by 5% via efficiency improvements, a potential 5% reduction in CO_2 emissions could be obtained as well.

As older, less efficient coal power plants are retired, their capacity may be replaced with new, more efficient coal-fired units. A new, fully proven supercritical coal plant design can operate at a heat rate 10-15% below the current coal fleet average, and therefore produce 10-15% less GHG than the average existing coal plant. Future more advanced ultra-supercritical plant designs with efficiencies above 40% would have heat rates that are 20-25% or more below the current coal fleet average, and therefore produce that much less GHG than the average existing coal plant.

Technology to capture and geologically sequester CO_2 is the subject of ongoing projects in the U.S. and other countries and is a promising technology.[250] The electric power sector will most likely be the largest potential market for carbon capture and sequestration (CCS) technologies, with the potential to reduce CO_2 by approximately 80 - 90% at an individual plant.[251] It may become possible to apply CCS to some portion of the existing coal-fired fleet by retrofit to achieve significant CO_2 reductions. Other facilities that might be able to use CCS include refineries, chemical manufacturing plants, ethanol production facilities, cement kilns and steel mills. As advances in GHG reduction technologies continue, section 111(d) standards would be expected to consider and reflect those advances over time. We solicit comment on the criteria EPA should use to evaluate whether CCS technology is adequately demonstrated to be available for the electric

[250] See http://www.netl.doe.gov/technologies/carbon_seq/partnerships/partnerships.html for more information about the Regional Carbon Sequestration Partnerships in the United States.
[251] IPCC Special Report on Carbon Dioxide Capture and Storage, 2005, pp. 3, 22.

power and other industrial sectors, including the key milestones and timelines associated with the wide-spread use of the technology.

iv. What are the possible effects of Section 111 with respect to innovation?

As noted previously, whatever path may be pursued with respect to the control of GHG through the CAA or other authority, we believe it is likely that most early reductions in stationary GHG emissions may occur as the result of increased energy efficiency, process efficiency improvements, recovery and beneficial use of process gases, and certain raw material and product changes that could reduce inputs of carbon or other GHG-generating materials. Clearly, more fundamental technological changes will be needed to achieve deeper reductions in stationary source GHG emissions over time. We request general comments on how to create an environment in which new, more innovative approaches may be encouraged pursuant to section 111, or other CAA or non-CAA authority.

Waiver authority under section 111(j) would be useful as one element of broader policies to encourage development of innovative technologies. Section 111(j) authorizes the Administrator to waive the NSPS requirements applicable to a source if he determines that the innovative technology the source proposes to use will operate effectively and is likely to achieve greater emission reductions, or at least equivalent reductions but at lower cost. Also, the Administrator must determine that the proposed system has not yet been adequately demonstrated (i.e. it is still an innovative technology), but that it will not cause or contribute to an unreasonable risk to public health, welfare, or safety in its operation, function, or malfunction. These waivers can be given for up to 7 years, or 4 years from the date that a source commences operation, whichever is earlier.

We believe that effective GHG reduction techniques for many source categories potentially subject to NSPS may at this time be limited and that additional research and development will be necessary before these controls are demonstrated to be effective. We ask for comment on how the use of innovative technology waivers could conceivably be used to foster the development of additional approaches for GHG reductions.

5. Possible Implications for Other CAA Provisions

Regulation of GHGs under a section 111 standard for any industry would trigger preconstruction permitting requirements for all types of GHG sources under the PSD program. NSPS are also incorporated into operating permits issued under Title V of the CAA. The consequences of triggering and the options for addressing these permitting requirements are addressed in detail in section VII.D of this notice.

Whether GHGs were regulated individually or as a group in NSPS standards would affect the definition of regulated pollutant for stationary sources subject to preconstruction permitting under the PSD program. Conversely, while the section 111 mechanisms are relatively independent of other CAA programs, NSPS decision-making as a practical matter would need to consider the pollutant definitions adopted under other CAA authorities. It would be advantageous to maintain consistency regarding the GHG pollutants subject to regulation elsewhere in the Act to avoid the potential for PSD review requirements for individual GHGs as well as for groups of the same GHGs.

In considering the impact that decisions to list pollutants under other authorities of the CAA might have on our use of section 111 authority, we note that some industries have processes that emit more than one GHG and a potential may exist among some of these industries to control emissions of one GHG in ways that may increase emissions of others (e.g., collecting methane emissions and combusting them to produce heat and/or energy, resulting in emissions of CO_2.) While an overall reduction in GHGs may occur, as well as a reduction in global warming potential, whether GHGs are regulated as a class of compounds or as individual constituents could have implications for the degree of flexibility and for the outcome of any regulatory decisions. More specifically, if we were to regulate GHGs as a group, then standards under section 111 might establish an overall level of performance that could accommodate increases in emissions of some gases together with reductions in others, so long as the overall performance target were met. If we were to regulate individual GHGs, then we may be less able to establish less stringent requirements for the control of some gases, while setting more stringent requirements for others. The extent to which we may be able to do so depends on the significance of the emissions of each gas from the source category in question as well as the feasibility and cost-effectiveness of controlling each. One result of this lessened flexibility may be the preclusion of certain approaches that could yield greater net reduction in GHG emissions. For this reason, we request comments on (1) the extent to which we are limited in our flexibility to regulate GHG as a class if listed individually under other CAA authorities, and (2) whether regulation under section 111 should be treat GHG emissions as a class for determining the appropriate systems for emissions reduction and resulting standards.

Finally, we note that our authority to promulgate 111(d) standards for existing sources depends on the two restrictions noted above. First, section 111(d) prohibits regulation of a NAAQS pollutant under that section. Second, "where a source category is being regulated under section 112, a section 111(d) standard of performance cannot be established to address any HAP listed under 112(b) that may be emitted from that particular source category." If we were to promulgate a section 111(d) emission standard and then subsequently take action under sections 108 or 112 such that we could not promulgate a section 111(d) standard had we not already done so, the continued validity of the section 111(d) regulations might become unclear. We request comment on the extent, if any, to which the requirements of section 111(d) plans would, or could, remain in force under such circumstances.

C. National Emission Standards for Hazardous Air Pollutants

Along with the NAAQS system and section 111 standards, section 112 is one of the three main regulatory pathways under the CAA for stationary sources. Section 112 is the portion of the Act that Congress designed for controlling hazardous air pollutant emissions from these sources, including toxic pollutants with localized or more geographically widespread effects. This focus is reflected in the statutory provisions, which, for example, require EPA to regulate sources with relatively small amounts of emissions. In comparison to section 111, section 112 provides substantially less discretion to EPA concerning the size and types of sources to regulate, and is specific about when EPA may and may not consider cost.

This section explores the implications if EPA were to list GHGs as hazardous air pollutants under section 112.

1. What Does Section 112 Require?

a. Overview

Section 112 contains a list of hazardous air pollutants (HAPs) for regulation. EPA can add or delete pollutants from the list consistent with certain criteria described below.

EPA must list for regulation <u>all</u> categories of major sources that emit one or more of the HAPs listed in the statute or added to the list by EPA. A major source is defined as a source that emits or has the potential to emit 10 tons per year or more of any one HAP or 25 tons per year of any combination of HAPs.

For each major source category, EPA must develop national emission standards for hazardous air pollutants (NESHAP). Standards are required for existing and new major sources. The statute requires the standards to reflect "the maximum degree of reduction in HAP emissions that is achievable, taking into consideration the cost of achieving the emission reduction, any nonair quality health and environmental impacts, and energy requirements." This level of control is commonly referred to as maximum achievable control technology, or MACT.

The statute also provides authority for EPA to list and regulate smaller "area" sources of HAPs. For those sources EPA can establish either MACT or less stringent "generally available control technologies or management practices".

Section 112(d)(6), requires a review of these technology-based standards every 8 years and requires that they be revised ''as necessary taking into account developments in practices, processes and control technologies.'' Additionally, EPA under section 112(f)(2)(C) must reevaluate MACT standards within 8 years of their issuance to determine whether MACT is sufficient to protect public health with an ample margin of safety and prevent adverse environmental effects. If not, EPA must promulgate more stringent regulations to address any such "residual risk".

b. How Are Pollutants and Source Categories Listed for Regulation under Section 112?

Section 112(b)(1) includes an initial list of more than 180 HAPS. Section 112(b)(2) requires EPA to periodically review the initial HAP list and outlines criteria to be applied in deciding whether to add or delete particular pollutants.

A pollutant may be added to the list because of either human health effects or adverse environmental effects. With regard to adverse human health effects, the provision allows listing of pollutants "including, but not limited to, substances which are known to be, or may reasonably be anticipated to be, carcinogenic, mutagenic, teratogenic, neurotoxic, which cause reproductive dysfunction, or which are acutely or chronically toxic." An adverse environmental effect is defined as "any significant and widespread adverse effect, which may reasonably be anticipated, to wildlife, aquatic life, or other natural resources, including adverse impacts on populations of endangered or threatened species or significant degradation of environmental quality over broad areas." Section 112(b)(2) provides that "no substance, practice, process or activity regulated under [the Clean Air Act's stratospheric ozone protection program] shall be subject to regulation under this section solely due to its adverse effects on the environment." Thus, section 112 may not be used to regulate certain chlorofluorocarbons and other ozone-depleting substances, their sources, or activities related to their production and use to address climate change unless we establish that such regulations are necessary to address human health effects in addition to any adverse environmental impacts. See section 602 of the Clean Air Act for a partial list of these substances.

Section 112(b)(3) of the Act establishes general requirements for petitioning EPA to modify the HAP list by adding or deleting a substance. Although the Administrator may add or delete a substance on his own initiative, if a party petitions the Agency to add or delete a substance, the burden historically has been on the petitioner to include sufficient information to support the requested addition or deletion under the substantive criteria set forth in CAA section 112(b)(3)(B) and (C). The Administrator must either grant or deny a petition within 18 months of receipt of a complete petition.

The effects and findings described in section 112 are different from other sections of the CAA addressing endangerment of public health discussed in previous sections of today's notice. Given the nature of the effects identified in section 112(b)(2), we request comment on whether the health and environmental effects attributable to GHG fall within the scope of this section. We also request comment on direct and indirect GHG emissions from existing source categories currently subject to regulation under section 112, any assessment of the relative costs of regulating GHG under the authority of section 112, and any co-benefits or co-detriments with regard to controlling GHG and the emissions of HAP.

The source categories to be regulated under section 112 are determined based on the list of HAP. Section 112(c) requires EPA to publish a list of all categories and subcategories of major sources of one or more of the listed pollutants, and to periodically review and update that list. In doing this, EPA also is required to list each category or subcategory of area sources which the Administrator finds presents a threat of adverse effects to human health or the environment (by such sources individually or in the aggregate) warranting regulation under section 112.

c. How Is MACT Determined?

In essence, MACT standards are intended to ensure that all major sources of HAP emissions achieve the level of control already being achieved by the better controlled and lower emitting sources in each category. This approach provides assurance to citizens that each major source of toxic air pollution will be required to effectively control its emissions. At the same time, this approach provides assurances that facilities that employ cleaner processes and good emissions controls are not disadvantaged relative to competitors with poorer controls.

MACT is determined separately for new and existing sources. For existing sources, MACT standards must be at least as stringent as the average emissions limitation achieved by the best performing 12 percent of sources in the category or subcategory (or the best performing five sources for source categories with less than 30 sources). This level is called the “MACT floor.” For new or reconstructed sources, MACT standards must be at least as stringent as the control level achieved in practice by the best controlled similar source.[252] EPA also must consider more stringent "beyond-the-floor" control options for MACT. When considering beyond-the-floor options, EPA must consider not only the maximum degree of reduction in emissions of the HAP, but also costs, energy requirements and non-air quality health environmental impacts of imposing such requirements.

MACT standards may require the application of measures, processes, methods, systems, or techniques including, but not limited to, (1) reducing the volume of, or eliminating emissions of, such pollutants through process changes, substitution of materials, or other modifications; (2) enclosing systems or processes to eliminate emissions; (3) collecting, capturing, or treating such pollutants when released from a process, stack, storage or fugitive emissions point; (4) design, equipment, work practice, or operational standards (including requirements for operator training or certification) as provided in subsection (h); or (5) a combination of the above. (See section 112(d)(2) of the Act.)

For area sources, CAA section 112(d)(5) provides that the standards may reflect generally available control technology or management practices (GACT) in lieu of MACT.

d. What Is Required to Address Any Residual Risk?

[252] See CAA section 112(d)(3).

Section 112(f)(2) of the CAA requires us to determine for each section 112(d) source category whether the MACT standards protect public health with an ample margin of safety. If the MACT standards for a HAP ‘‘classified as a known, probable, or possible human carcinogen do not reduce lifetime excess cancer risks to the individual most exposed to emissions from a source in the category or subcategory to less than 1-in-1-million,’’ EPA must promulgate residual risk standards for the source category (or subcategory) as necessary to protect public health with an ample margin of safety. EPA must also adopt more stringent standards if needed to prevent an adverse environmental effect, but must consider cost, energy, safety, and other relevant factors in doing so. EPA solicits comments on the extent to which these programs could apply with respect to the possible regulation of sources of GHG under section 112, including the relevance of any carcinogenic effects of individual GHG.

2. What Sources Would Be Affected If GHGs Were Regulated under this Authority?

If GHGs were listed as HAP, EPA would be required to regulate a very large number of new and existing stationary sources, including smaller sources than if alternative CAA authorities were used to regulate GHG. This is the result of three key requirements. First, the section 112(a) major sources thresholds of 10 tons for a single HAP and 25 for any combination of HAPs would mean that very small GHG emitters would be considered major sources. Second, section 112(c) requires EPA to list all categories of major sources. Third, section 112(d) requires EPA to issue MACT standards for all listed categories.

We believe that most significant stationary source categories of GHG emissions have already been listed under section 112 (although the 10-ton threshold in the case of GHGs would be expected to bring in additional categories such as furnaces in buildings, as explained below). To date we have adopted standards for over 170 categories and subcategories of major and area sources. This is a significantly greater number than the categories for which we have adopted NSPS because under section 112 we must establish standards for all listed categories, whereas section 111 requires that we identify and regulate only those source categories that contribute "significantly" to air pollution endangering public health and welfare.

3. What Are the Key Milestones and Expected Timeline If Section 112 Were Used for GHG Controls?

One possible timetable for addressing GHG under this part of the Act would be to incorporate GHG emission control requirements concurrent with the mandatory 8-year technology reviews for each category, collecting information on emissions and control technologies at the time the existing MACT standards are reviewed to determine whether revisions are needed. If we were to list new source categories under section 112, EPA would be required to adopt MACT standards for those categories within 2 years of the date of category listing.

EPA must require existing sources to comply within 3 years of a standard's promulgation, although states and EPA are authorized in certain circumstances to extend the period of compliance by one additional year. Most new sources must comply as soon as a section 112 standard is issued; however, there is an exception where the final rule is more stringent than the proposal.

Because of the more detailed requirements for identifying appropriate levels of control to establish a level for MACT, significantly more information on the best performing sources is needed under section 112 than under section 111, making the development of such standards within 2 years after listing a source category difficult. We request comment on this and other approaches for addressing GHG under section 112, both for categories already listed for regulation and for any that might appropriately be added to the section 112 source category list if we were to elect to regulate GHGs under this section.

4. What Are the Key Considerations Regarding Use of this Authority for GHGs (and How Could Potential Issues be Addressed)?

A key consideration in evaluating use of section 112 for GHG regulation is that the statutory provisions appear to allow EPA little flexibility regarding either the source categories to be regulated or the size of sources to regulate. As described above, EPA would be required to regulate a very large number of new and existing stationary sources, including smaller sources than if alternative CAA authorities were used to regulate GHG. For example, in calculating CO2 emissions based on fossil-fuel consumption, we believe that small commercial or institutional establishments and facilities with natural gas-fired furnaces would exceed this major source threshold; indeed, a large single-family residence could exceed this threshold if all appliances consumed natural gas. EPA requests comment on the requirement to establish standards for all sources under section 112 relevant to GHG emissions and whether any statutory flexibility is or is not available with respect to this requirement and GHGs.

A section 112 approach for GHGs would require EPA to issue a large number of standards based on assessments for each source category. Determining MACT based on the best-controlled 12 percent of similar sources for each category would present a difficult challenge, owing to our current lack of information about GHG control by such sources and the effort required to obtain sufficient information to establish a permissible level of performance.

GHG regulation under section 112 would likely be less cost effective than under some CAA authorities, in part because section 112 was designed to ensure a MACT level of control by each major source, and thus provides little flexibility for market-oriented approaches. Given the structure and past implementation of section 112, this section may not provide EPA with authority to allow emissions trading among facilities or averaging across emitting equipment in different source categories. This is because the statutory terms of section 112 provide that emission standards must be established for sources within "each category" and those standards must be no less stringent than the “floor,” or the level of performance achieved by the best-performing sources within that category. Each source in the category must then achieve control at least to this floor level. Trading would allow sources to emit above the floor. In addition, it may not be possible to assess individual source fence line risk for section 112(f) residual risk purposes if the sources did not each have fixed limits. Finally, the section 112 program is in part designed to protect the population in the vicinity of each facility, which trading could undermine (in contrast to an ambient standard). Given the global nature of GHGs and the lack of direct health effects from such emissions at ambient levels, EPA requests comments on the extent to which the CAA could be interpreted to grant flexibility to consider such alternative implementation mechanisms, and what, if any, limitations should be considered appropriate in conjunction with them.

Another reason that section 112 regulation of GHGs would be expected to be less cost effective than other approaches is that the statute limits consideration of cost in setting MACT standards. As described above, the statute sets minimum stringency levels, or "floors," for new and existing source standards. Cost can only be considered in determining whether to require standards to be more stringent than the floor level.

A further consideration is that the short compliance timetables – immediate for most new sources, and within 3-4 years for existing sources – appear to preclude setting longer compliance timeframes to allow for emerging GHG technologies to be further developed or commercialized.

5. What Are the Possible Implications for Other Provisions of the Clean Air Act?

As provided under section 112(b)(6), pollutants regulated under section 112 of the Act are exempt from regulation under the PSD program. Also, a section 111(d) standard of performance for existing sources cannot be established to address any HAP listed under section 112(b) that that is emitted from a source category regulated under section 112.[253]

If EPA were to list GHGs under section 108 of the CAA for purposes of establishing NAAQS, we would be prevented by section 112(b)(2) from listing and regulating them as HAPs under this section of the Act. However, it is less clear that the reverse is true; that is, if a pollutant were first listed under section 112 and then EPA decided to list and regulate it under section 108, the statute does not clearly say whether that is permissible, or whether EPA would then have to remove the pollutant from the section 112 pollutant list. We request comment on the extent to which this apparent ambiguity in the Act poses an issue regarding possible avenues for regulating GHG and if so, how it should be addressed.

In light of the foregoing, we request comment on the appropriateness of section 112 as a mechanism for regulating stationary source emissions of GHGs under the CAA. If commenters believe use of section 112 would be appropriate, we further request comments on which GHGs should be considered, what additional sources of emissions should be listed and regulated, and how MACT should be determined for GHG emission sources.

D. Solid Waste Combustion Standards

1. What Does Section 129 Require?

[253] It is important to note that many sources may be subject to standards under both section 111 and 112; however these standards establish requirements for the control of different pollutants.

Section 129 of the CAA requires EPA to set performance standards under section 111 to control emissions from solid waste incineration units of at least 9 specific air pollutants. It directs EPA to develop standards which include emission limitations and other requirements for new units and guidelines and other requirements applicable to existing units.

Section 129 directs EPA to set standards for "each category" of such units, including those that combust municipal, hospital, medical, infectious, commercial, or industrial waste, and "other categories" of solid waste incineration units, irrespective of size. The pollutants to be addressed by these standards include the NAAQS pollutants particulate matter (total and fine), sulfur dioxide, oxides of nitrogen, carbon monoxide, and lead; and the hazardous air pollutants hydrogen chloride, cadmium, mercury, and dioxins and dibenzofurans. EPA is authorized to regulate additional pollutants under these provisions, but section 129 includes no endangerment test or other criteria for determining when it is appropriate to do so.

Although the emission standards called for by section 129 are to be established pursuant to section 111, the degree of control required under those standards more closely resembles that of section 112(d). For new sources the level of control is required to be no less stringent than that of the best performing similar source, while for existing sources the level of control is to be no less stringent than the average of the top 12% of best-performing sources. For both new and existing source standards, beyond these "floor" levels EPA must consider the cost of achieving resulting emission reductions and any non-air quality health and environmental impacts and energy requirements in determining what is achievable for units within each category. The performance standards must be reviewed every 5 years. Additionally, for those pollutants that are listed under section 112 as a HAP, EPA must reevaluate the standards in accordance with section 112(f) to determine whether they are sufficient to protect public health with an ample margin of safety and prevent adverse environmental effects, and must promulgate more stringent regulations if necessary to address any such “residual risk.” Thus, for this particular class of source categories, section 129 merges important elements of both sections 111 and 112.

EPA has established standards for a variety of solid waste incinerator categories and is in the process of developing additional standards and revising others.[254] In the absence of statutory criteria for determining whether and under what circumstances EPA should regulate additional pollutants under this section of the CAA, we request comment on whether emissions of GHG could fall within the scope of this section. We also request comment on direct and indirect GHG emissions from existing source categories currently subject to regulation under section 129, any assessment of the relative costs of regulating GHGs under the authority of section 129, and any co-benefits or co-detriments with regard to controlling GHG and the emissions of pollutants specifically listed for regulation under section 129.

2. What Sources Would Be Affected If GHGs Were Regulated Under this Authority?

[254] Rules have been promulgated for large and small municipal waste combustors; medical waste incinerators; other solid waste incinerators; and commercial, institutional, and industrial solid waste incinerators. EPA is also currently reevaluating and revising certain standards under section 129 in response to decisions by the U.S. Court of Appeals for the D.C. Circuit.

Standards required by section 129 are applicable to “any facility which combusts any solid waste material from commercial or industrial establishments or the general public (including single and multiple residences, hotels, and motels).” Thus the provisions of this section are limited to a specific type of emission source, although there are many such units in existence that are subject to regulation. To date we have adopted standards for five categories of incinerators and are currently in the process of developing revised standards on remand for several of these categories, which may involve the inclusion of several additional subcategories of incineration units. We anticipate that when completed these rules will establish standards of performance for as many as five hundred or more units.

Because section 129 does not require, but authorizes EPA to establish requirements for other air pollutants, we request comment on whether and for what categories or subcategories of incinerators EPA could address GHG emissions control requirements.

a. How Are Control Requirements Determined?

As noted above, the control requirements for sources regulated under section 129 are similar to the MACT standards mandated under section 112(d). However, whereas section 112(d)(3) provides that standards are to be based on the best performing sources “for which the Administrator has emissions information,” section 129 contains no such limitation. Consequently, it appears that EPA is obligated to obtain information from all potentially affected sources in order to determine the appropriate level of control.

Section 129(a)(2) provides authority for EPA to distinguish among classes, types, and sizes of units within a category in establishing standards. This provision is similar to authorities provided in sections 111(b)(2) and 112(b)(2). Because section 129 directs that EPA establish standards for affected source categories under sections 111(b) and (d), we believe that the provisions governing the creation of design, equipment, work practice, or operational standards are also available for standards required by section 129. For existing sources, we believe that provisions for consideration of remaining useful life and other related factors are relevant to EPA and States when determining the requirements and schedules for compliance for individual affected sources.

b. What Is Required to Address Any Residual Risk?

For each of the air pollutants named in section 129 that are listed as HAP under section 112, section 129 requires EPA to evaluate and address any residual risk remaining after controls established under the initial emission standards.[255] In so doing, it requires EPA to determine for each affected source category whether the performance standards protect public health with an ample margin of safety. EPA must also adopt more stringent standards if needed to prevent an adverse environmental effect, but must consider cost, energy, safety, and other relevant factors in doing so.

Section 129(h)(3) limits residual risk assessments and any subsequent resulting regulations to "the pollutants listed under subsection (a)(4) of this section and no others."

[255] Section 129(h)(3) provides that for purposes of considering residual risk the standards under section 129(a) and section 111 applicable to categories of solid waste incineration units are to be "deemed standards under section 112(d)(2)."

Consequently, if EPA were to regulated GHG emissions from incineration units under section 129, we would not be required to conduct additional residual risk determinations.

3. What Are the Key Milestones and Expected Timeline If Section 129 Were Used for GHG Controls?

As stated above, we have adopted rules governing emissions from certain categories of solid waste incineration units and are in the process of revising or establishing new standards for others. Thus if we were to elect to regulate GHG emissions under section 129, a question arises concerning how to incorporate new requirements for those categories for which standards have already been established. One possible timetable for addressing GHG under this part of the Act would be to incorporate GHG emission control requirements concurrent with the mandatory 5-year reviews for each previously-regulated category, collecting information on emissions and control technologies at the time the existing standards are reviewed to determine whether revisions are needed. Because of the more detailed requirements for identifying appropriate levels of control to establish a level for these categories of sources, significantly more information on the best performing sources is needed under section 129 than even under section 112 (because of the absence of limitations for this analysis to those sources "for which the Administrator has information"), making the development of such standards a more time-consuming effort. In the event that we were to elect to regulate GHGd under this section, we request comment on this and other approaches for addressing GHGd under section 129, both for categories already regulated and for any for which standards are currently under development.

4. What Are the Key Considerations Regarding Use of this Authority for GHGs (and How Could Potential Issues Be Addressed)?

If we were to elect to regulate GHG emissions from solid waste incinerators under section 129, then we would need to establish standards for at least some number of categories of such sources. We request comment on the availability of authority to establish requirements for controlling GHG emissions from subcategories of incineration units based on size, type or class, as provided under section 111, and to exclude from regulation other categories or subcategories.

Given the structure of section 129 and its hybrid approach to the use of authorities under sections 111 and 112, we question whether this section provides EPA with available authority to establish alternative compliance approaches, such as emissions trading or averaging across sources within a category. This is because the statutory terms of section 129 provide that emission standards must be established for sources within "each category" and those standards must be no less stringent than the level of performance achieved by the best-performing sources within that category. Each source in the category must then achieve control at least to this level. Trading would allow sources to emit above the floor. As a practical matter, given that requirements for control of specifically-listed pollutants may preclude trading for those pollutants, and given that many of the controls applicable to those pollutants would be the same as or similar to those that would be applicable to GHGs, we believe that trading options would likely be infeasible with respect to GHG control requirements. However, EPA requests comments on the extent to which the CAA could be interpreted to grant flexibility to consider such alternative implementation mechanisms, to what extent, and what, if any, limitations should be considered appropriate in conjunction with them.

5. What Are the Possible Implications for Other Provisions of the Clean Air Act?

Section 129 recognizes that many incineration units may also be subject to prevention of significant deterioration or nonattainment new source review requirements. It addresses potentially conflicting outcomes of control determinations under those programs by providing that "no requirement of an applicable implementation plan . . . may be used to weaken the standards in effect under this section."

If EPA were to list GHGs under section 108 for purposes of establishing NAAQS, we would not be prevented from regulating them under this section of the Act as well. If EPA were to list GHG under section 112, a potential conflict arises in that section 112 establishes major and area source emissions thresholds, providing for standards of different stringency for each, and requires analysis of residual risk for major sources regulated under that section of the Act. We request comments on how such apparent conflicts could be reconciled if we were to elect to regulate emissions of GHGs from solid waste incineration units under section 129.

In light of the foregoing, we request comment on the appropriateness of section 129 as a mechanism for regulating incineration unit emissions of GHGs under the CAA. If commenters believe that use of section 129 would be appropriate, we further request comments on which GHGs should be considered, what source categories or subcategories should be regulated, and how appropriate control requirements should be determined for new and existing GHG emission sources.

E. Preconstruction Permits under the New Source Review (NSR) Program

1. What Are the Clean Air Act Provisions Describing the NSR Program?

Under what is known as the New Source Review (NSR) program, the CAA requires the owners and operators of large stationary sources of air pollution to obtain construction permits prior to building or modifying such a facility. The program is subdivided into the Prevention of Significant Deterioration (PSD) and nonattainment NSR (NNSR) programs, either of which may be applicable depending on the air quality for a particular pollutant in the location of the source subject to permitting.

The PSD program, set forth in Part C of Title I of the CAA, applies in areas that are in attainment with the NAAQS (or are unclassifiable) and has the following five goals and purposes:

- to protect public health and welfare from air pollution beyond that which is addressed by the attainment and maintenance of NAAQS;
- to protect specially designated areas such as national parks and wilderness areas from the effects of air pollution;

- to assure that economic growth will occur in a manner consistent with the preservation of existing clean air resources;
- to assure emissions in one state will not interfere with another state's PSD plan; and
- to assure that any decision to permit increased air pollution is made only after evaluating the consequences of the decision and after opportunities for informed public participation.

The main element of the PSD program is the requirement that a PSD permit be obtained prior to construction of any new "major emitting facility" or any new "major modification." Before a source can receive approval to construct under PSD, the source and its permitting authority (usually a state or local air pollution control agency, but sometimes EPA) must follow certain procedural steps, and the permit must contain certain substantive requirements. The most important procedural step is providing an opportunity for the public to comment when a permitting authority proposes to issue a permit.

The PSD program primarily applies to all pollutants for which a NAAQS is promulgated, but some of the substantive requirements of the PSD program also apply to regulated pollutants for which there is no NAAQS (except that there is an explicit statutory exemption from PSD for HAPs).[256] Since there is currently no NAAQS for GHGs and GHGs are not otherwise subject to regulation under the CAA, the PSD program is not currently applicable to GHGs.[257] However, as discussed in section IV of

[256] CAA section 112(b)(6)
[257] In the Energy Independence and Security Act of 2007 (EISA), Congress provided that regulation of GHGs under CAA section 211(o) would not automatically result in regulation of GHGs under other CAA

this notice, it is possible that EPA actions under other parts of the CAA could make GHGs pollutants subject to regulation under the Act and thus subject to one or more parts of the PSD program.

If EPA were to promulgate a rule establishing limitations on GHG emissions from mobile sources or stationary sources without promulgating a NAAQS for GHGs, the PSD requirement of greatest relevance would be the requirement that a permit contain emissions limits that reflect the Best Available Control Technology (BACT). BACT is defined as the maximum achievable degree of emissions reduction for a given pollutant (determined by the permitting authority on a case-by-case basis), taking into account energy, environmental, and economic impacts. BACT may include add-on controls, but also includes application of inherently lower-polluting production processes and other available methods and techniques for control. BACT cannot be less stringent than any applicable NSPS.

Since emission control requirements will likely have the most direct impact on new or modified stationary sources subject to PSD, our focus in this notice is on the BACT requirement. However, we are also interested in stakeholder input on the extent to which we should evaluate other substantive PSD program elements which would be affected by any possible EPA action to regulate GHGs under other parts of the Act. These include the requirements to evaluate, in consultation with the appropriate Federal Land Manager (FLM), the potential impact of proposed construction on the Air Quality

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provisions. Because of this provision, EISA does not impact the interrelationship of other provisions of the CAA, and we only reference the HAP exception in the text.

Related Values of any affected "Class I area" (national parks, wilderness areas, etc.) and additional impacts analysis.[258]

If EPA were to promulgate a NAAQS for GHGs, because of the relatively uniform concentration of GHGs, we expect that the entire country would be in nonattainment or attainment of the NAAQS. The preconstruction permitting requirements that apply would depend on whether the country is designated as nonattainment or attainment for the GHG emissions that would increase as a result of a project being constructed.

If the entire country is designated attainment, and PSD applies, the adoption of a NAAQS would trigger air quality analysis requirements that are in addition to all the requirements described above. For example, under CAA section 165(a)(3), permit applicants have to conduct modeling to determine whether they cause or contribute to a NAAQS violation. Following promulgation of a NAAQS, EPA may also promulgate a PSD increment for GHGs, which would require additional analysis for each new and modified source subject to PSD.[259] However, this notice does not address in detail the PSD elements that relate to increments.

Under a GHG NAAQS with the country in nonattainment, the nonattainment NSR permitting program would be triggered nationally. The nonattainment NSR program requirements are contained in section 173 of the Act. Like PSD, they apply to new and modified major stationary sources, but they contain significantly different requirements from the PSD program. A key difference is the requirement that the emissions increases

[258] As codified at 40 CFR 51.166(o), the owner or operator shall provide an analysis of the impairment to visibility, soils, and vegetation that would occur as a result of the source or modification and general commercial, residential, industrial, and other growth associated with the source or modification.

[259] PSD increments are air quality levels which represent an allowable deterioration in air quality as compared to the existing air quality level on a certain baseline date for a given area.

from the new or modified source in a nonattainment area must be offset by reductions in existing emissions from the same nonattainment area or a contributing upwind nonattainment area of equal or higher nonattainment classification. The offsetting emissions reductions must be at least equal to the proposed increase and must be consistent with a SIP that assures the nonattainment area is making reasonable progress toward attainment.[260] Another key difference is that instead of BACT, sources subject to nonattainment NSR must comply with the Lowest Achievable Emission Rate (LAER), which is the most stringent emission limitation that is (1) contained in any SIP for that type of source, or (2) achieved in practice for sources of the same type as the proposed source.[261] Notably, if the rate is achievable, LAER does not allow for consideration of costs or of the other factors that BACT does. While LAER and offsets are likely of greatest significance for GHG regulation under nonattainment NSR, there are additional requirements for nonattainment NSR that would also apply. The additional requirements include the alternatives analysis requirement; the requirement that source owners and operators demonstrate statewide compliance with the Act; and the prohibition against permit issuance if the SIP is not being adequately implemented.

For simplicity, the remainder of this notice describing affected sources, impacts, and possible tailoring generally focuses on PSD, raising issues specific to nonattainment NSR where applicable.

2. What Sources Would Be Affected If GHGs Were Regulated under NSR?

[260] CAA section 173(a)(1); limitations on offsets are set forth in section 173(c).
[261] CAA section 173(a); LAER is defined in section 171(3)(A).

A PSD permit is required for the construction or modification of "major emitting facilities," which are commonly referred to as "major sources." A "major emitting facility" is generally any source that emits or has the potential to emit 250 tons per year (tpy) of a regulated NSR pollutant.[262,263] A source that belongs to one of several specifically identified source categories is considered a major source if it emits or has the potential to emit 100 tpy of a regulated NSR pollutant.[264] Also, for nonattainment NSR, the major source threshold is at most 100 tpy, and is less in some nonattainment areas, depending on the pollutant and the nonattainment classification.

A "major modification" is any physical change or change in the method of operation of a major source which significantly increases the amount of emissions of any regulated NSR pollutant. EPA defines what emissions levels of a pollutant are "significant" through regulation, and the defined significance levels range from 0.3 tpy for lead to 100 tpy for CO. Currently there is no defined significance level for GHGs (either individually or as a group) because they are not regulated NSR pollutants, and thus, were GHGs to become regulated, the significance threshold would be zero. Note that, when determining whether a facility is "major," a source need not count fugitive emissions (i.e., emissions which may not reasonably be vented through stacks, vents, etc.) unless it is in a listed category.

As noted in section IV, GHGs are not currently subject to regulation under the Act, and therefore are not regulated NSR pollutants. However, if GHG emissions

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[262] 42 U.S.C. 7569(1). The PSD regulations use the term "major stationary source." 40 CFR 51.166(b)(1) The definition of "regulated NSR pollutant" is at 40 CFR 51.166(b)(49).

[263] "Potential-to-emit", or PTE, is defined as the maximum capacity of a source to emit any air pollutant under its physical and operational design.

[264] These specific sources include major industrial categories such as petroleum refining, fossil-fuel fired steam electric plants, chemical process plants, and 24 other categories. The full list of 100 tpy major sources is promulgated at 40 CFR 51.166(b)(1)(i)(a).

become subject to regulation under any of the stationary or mobile source authorities discussed above (except sections 112 and 211(o)), GHGs could become regulated NSR pollutants. Many types of new GHG sources and GHG-increasing modifications that have not heretofore been subject to PSD would become subject to PSD permitting requirements. This is particularly true for CO_2 because, as noted in section III, the mass CO_2 emissions from many source types are orders of magnitude greater than for currently regulated pollutants. Thus, many types of new small fuel-combusting equipment could become newly subject to the PSD program if CO_2 becomes a regulated NSR pollutant. As discussed below in the section on potential to emit, the extent to which such equipment would become subject to PSD would depend upon whether, for each type of equipment, its maximum capacity considering its physical and operational design would involve constant year-round operation or some lesser amount of operation. For example, the calculated size of a natural gas-fired furnace that has a potential to emit 250 tpy of CO_2 ,if year-round operation (8760 hours per year) were assumed,- would be only 0.49 MMBTU/hr, which is comparable to the size of a very small *commercial* furnace. In practice, a furnace like this would likely operate far less than year round and its actual emissions would be well below 250 tpy. For example, such a furnace, if used for space heating, might only be burning gas for about 1000 hours per year, meaning that it would need to be sized at over 4 MMBTU/hr – a size more comparable to a small *industrial* furnace -- to actually emit 250 tons of CO2. For sources such as these, the interpretation of the term “potential to emit” and the availability of streamlined mechanisms for smaller sources to limit their potential to emit would determine whether they would be considered “major” for GHG emissions under PSD.

For sources already major for other pollutants, it is likely that many more changes made by the source would also qualify as major modifications and become subject to PSD as well, unless potential approaches (including those discussed below) for raising applicability thresholds were implemented. Relatively small changes in energy use that cause criteria pollutant emissions too small to trigger PSD would newly trigger PSD at such facilities because such changes would likely result in greater CO_2 increases. For example, consider a hypothetical 500 MW electric utility boiler firing a bituminous coal that is well-controlled for traditional pollutants. Such a boiler, operating more than 7000 hours per year (out of a possible 8760), can emit approximately 4 million tons of CO_2 per year, or more than 580 tons per hour. Assuming a 100 tpy significance level (rather than the current zero level for GHGs), any change resulting in just 10 additional minutes of utilization over the course of a year at such a source would be enough to result in an increase of 100 tons and potentially subject the change to PSD. By contrast, to be considered a modification for NOx, the same change would require approximately 36 additional hours of operation assuming that the hypothetical source had a low-NOx burner, and 90 additional hours of operation assuming that the source also employed a selective catalytic reduction add-on control device.

Once a source is major for any NSR regulated pollutant, PSD applies to significant increases of *any other* regulated pollutant, so significant increases of GHGs would become newly subject to PSD at sources that are now major for other regulated pollutants. Similarly, significant increases of other pollutants would become subject to PSD if they occur at sources previously considered minor, but which become classified as major sources for GHG emissions.

Currently, EPA estimates that EPA, state, and local permitting authorities issue approximately 200-300 PSD permits nationally each year for construction of new major sources and major modifications at existing major sources. Under existing major source thresholds, we estimate that if CO_2 becomes a regulated NSR pollutant (either as an individual GHG or as a group of GHGs), the number of PSD permits required to be issued each year would increase by more than a factor of 10 (i.e. more than 2000-3000 permits per year), unless action were taken to limit the scope of the PSD program under one or more of the legal theories described below. The additional permits would generally be issued to smaller industrial sources, as well as large office and residential buildings, hotels, large retail establishments, and similar facilities. These facilities consist primarily of equipment that combusts fuels of various kinds and release their exhaust gases through a stack or vent. Few of these additional permits would be for source categories (such as agriculture) where emissions are "fugitive," because, as noted above, fugitive emissions do not count toward determining if a source is a major source except in a limited number of categories of large sources.

Because EPA and states have generally not collected emissions information on sources this small, our estimate of the number of additional permits relies on limited available information and engineering judgment, and is uncertain. Our estimate of the number of additional permits is also not comprehensive. First, it does not include permits that would be required for modifications to existing major GHG sources because the number of these is more difficult to estimate.[265] Nonetheless, we anticipate that, for

[265] Among other things, any estimate of modifications must take into account the netting provisions of NSR, in which sources can avoid NSR if the increase of pollutant emissions from a project is below the significance level for that pollutant, after taking into account other increases and decreases of emissions that are contemporaneous with the project.

modifications, coverage of GHGs would increase because the larger universe of major sources will bring in additional sources at which modifications could occur and because for “traditional” major sources, many more types of small modifications that were minor for traditional pollutants could become major due to increases in GHG emissions that exceed the significance levels. Second, EPA’s estimate is uncertain because it is based on actual emissions, and thus excludes a potentially very large number of sources that would be major if they operated at their full potential-to-emit (PTE) (i.e. they emitted at a level that reflects the maximum capacity to emit under their physical and operational design), but which in practice do not. Such sources could be defined as major sources without an enforceable limitation on their PTE, but for the purposes of this estimate, we assume they have options for limiting their PTE and avoiding classification as a major source. (Nonetheless, there are important considerations in creating such PTE limits, as discussed below). Third, this estimate does not specifically account for CO_2 from sources other than combustion sources. While we know there are sources with significant non-combustion emissions of GHGs, there are relatively few of these compared to the sources with major amounts of combustion CO_2. These non-combustion sources would likely be major for combustion CO_2 in any event, and many of these are likely already major for other pollutants, though GHG regulation would likely mean increases in the number of major modifications at such sources.

We request any available information that would allow us to better characterize the number and types of sources and modifications that would become subject to the PSD program if CO_2 becomes a regulated NSR pollutant. As discussed below, we are particularly interested in information that would allow us to analyze the effects of different major source thresholds and significance levels.

Finally, we note that our estimates above are for CO_2. As described above in section IV, there are implications to regulating additional GHGs as pollutants, or GHGs in the aggregate. Our estimates of PSD program impacts do not include consideration of GHGs other than CO_2 because we expect that at the vast majority of these sources CO_2 will be the dominant pollutant. We ask for comment on whether there are large categories of potentially newly regulated PSD sources for individual GHGs besides CO_2. We also ask for comment on the effects of aggregating GHGs for PSD applicability. Aggregating GHGs could bring additional sources into PSD to the extent that other GHGs are present and would add enough to a source's PTE to make it a major source. On the other hand, under the netting provisions of the CAA, it may be easier to facilitate interpollutant netting if GHGs are aggregated (e.g., a source using netting to avoid PSD for a CO_2 increase based on methane decreases at the same source).

3. What are the key milestones and expected timeline if the PSD program were used for GHG controls?

Because PSD applies to all regulated pollutants except HAP, EPA's interpretation of the Act is that PSD program requirements would become applicable immediately upon the effective date of the first regulation requiring GHG control under the Act.[266] While

[266] Because PSD is implemented in many areas by states under EPA-approved state regulations, there may be a lag time in a small number of states if their PSD regulations are written in such a way that revision of the regulations (and EPA approval) would be required to give the state authority to issue permits for GHGs.

existing PSD permits would remain unaffected, from that point forward, each new major source of GHGs and each major modification at an existing major source that significantly increases GHGs would need to get a PSD permit before beginning construction. Control requirements could take effect as the first new and modified sources obtain their permits and complete construction of the permitted projects. Because of the case-by-case nature of the PSD permitting decisions, the complexity of the PSD permitting requirements, and the time needed to complete the PSD permitting process, it can take several months to receive a simple PSD permit, and more than a year to receive a permit for a complex facility. We ask for comment on whether there are additional timeline considerations not noted here.

4. What Are Key Considerations Regarding Application of the PSD Program to GHGs (and How Could Potential Issues Be Addressed?)

a. Program Scope

As noted above, regulating GHGs under the PSD program has the potential to dramatically expand the number of sources required to obtain PSD permits, unless action is taken to limit the scope of the program, as described below. Since major source thresholds were enacted before this assessment of the application of the PSD program to GHGs, it is reasonable to expect that Congress could consider legislative alterations to account for the different aspects of GHGs versus traditional air pollutants noted above

However this would not be the case for EPA's own regulations or for any state delegated to implement EPA regulations on our behalf.

(e.g., the relatively uniform atmospheric concentrations of GHGs versus more localized effects of traditional pollutants.) Possible ways to limit the scope of the program without legislation are described later in this section.

In the absence of such action, we would expect (assuming a 250 tpy major source threshold, or 100 tpy for statutorily specified source categories) at least an order-of-magnitude increase in the number of new sources required to obtain PSD permits, and an expansion of the program to numerous smaller sources not previously subject to it. While such sources may emit amounts of GHGs that exceed statutory thresholds, they have relatively small emissions of non-GHG pollutants (such that they have not been regulated under PSD, and many have not been regulated under any CAA program).[267] Regulating GHGs under the PSD program would also cause a large increase in the number of modifications at existing sources that would be required to obtain PSD permits. Such modifications may occur at existing sources that have been long regulated as major for other pollutants, or at existing sources that become classified as major solely due to their GHG emissions.

Permitting smaller sources and modifications is generally less effective due to the fact that, while there are still administrative costs borne by the source and permitting authority, the environmental benefit of each permit is generally less than what results from permitting a larger source. Congress excluded smaller sources from PSD by adopting 100 and 250 tpy major source cutoffs in 1977 when PSD was enacted, and EPA rules have long excluded smaller sources and modifications from the program. This

[267] Some fraction of these small sources are regulated, at least in some areas, by SIPs and state minor source permit programs under section 110 of the CAA.

cutoff would not exclude many smaller sources of GHGs because the mass emissions (i.e., tons per year) of the relevant GHG may be substantially higher than the mass emissions of traditional pollutants for the same process or activity. Thus, while existing cutoffs for traditional pollutants capture a relatively modest number of new and modified sources per year, applying those same major source levels to CO2, and possibly for other GHG, would capture a very large number of sources, many of which are comparatively smaller in size when compared to "traditional" sources. Similarly, for modifications, the current absence of a significance level, or the future adoption of a significance level that is below the current major source thresholds, would subject numerous small changes to PSD permitting requirements.

b. Potential Program Benefits

In the past, EPA has recognized that the PSD program can achieve significant emissions benefits over time as emissions increases from new major sources and major modifications are minimized through application of state-of-the-art technology.[268] As a result, other programs designed to reduce emissions are not compromised by growth in new emissions from PSD sources. Further emissions benefits are achieved when sources limit or reduce emissions to avoid PSD applicability.

A rationale for new source review since its inception has been that it is generally more effective and less expensive to engineer and install controls at the time a source (or major modification) is being designed and built, as BACT does, rather than retrofitting

[268] See, for example, Section II of "NSR Improvements: Supplemental Analysis of the Environmental Impact of the 2002 Final NSR Improvement Rules," U.S. EPA, November 21, 2002.

controls absent other construction.[269] In addition, the BACT determination process requires consideration of new emissions reduction technologies, which provides an ongoing incentive to developers of these technologies. There is the potential for avoiding or reducing GHG emissions if "traditional" sources begin to install abatement technologies for GHGs as they do for traditional pollutants. On the other hand, as discussed in section III,F, some suggest that regulations that apply stringent requirements to new sources and "grandfather" existing sources may create incentives to keep older and inefficient sources in use longer than otherwise would occur, diminishing the incentive for technological innovation and diffusion and reducing the environmental effectiveness and cost effectiveness of the regulation. Others believe that economic factors other than these regulatory differences tend to drive business decisions on when to build new capacity. EPA examined the effect of new source review on utilities and refineries in a 2002 report, as described in section III.F.4 of this notice.[270]

EPA has not performed an analysis of the GHG emissions that might be avoided or reduced under PSD preconstruction permitting, nor of possible increases through unintended incentives. Such an analysis would necessarily involve new analysis of potential BACT technologies, considering costs and other factors, for GHGs emitted by numerous sectors. The PSD program, through the BACT requirement, might result in

[269] Critics of this rationale suggest that under a market-oriented system covering both new and existing sources, source owners would be best placed to decide whether it is economic to place state-of-the-art controls on new sources.

[270] See U.S. EPA, "New Source Review: Report to the President, June 2002." As noted in section III.F of this notice, ,the report concluded (pp. 30-31) that, for existing sources,, "[c]redible examples were presented of cases in which uncertainty about the exemption for routine activities has resulted in delay or resulted in the cancellation of projects which sources say are done for purposes of maintaining and improving the reliability, efficiency and safety of existing energy capacity. Such discouragement results in lost capacity, as well as lost opportunities to improve energy efficiency and reduce air pollution." With respect to new facilities, the report said, "there appears to be little incremental impact of the program on the construction of new electricity generation and refinery facilities."

installation of such technologies as CCS, or the incorporation of other CO_2 reducing technologies, such as more efficient combustion processes.[271] However, it is not possible at this time to estimate these effects in light of the uncertainty surrounding the future trends in construction at new and modified sources, demonstration of commercial availability of various GHG control technology options, their control effectiveness, costs, and the aforementioned incentives to keep existing sources in operation and avoid modifying them. We ask for comment on the nature (and to the extent possible, the magnitude) of the potential effects of PSD on GHG emissions, and whether these effects vary between new and existing sources.

Regarding the potentially large universe of smaller sources and modifications that could become newly subject to BACT, as described above, there are large uncertainties about the potential benefits of applying BACT requirements to GHG emissions from such sources. Individual emission reduction benefits from such sources would be smaller; however, the cumulative effect could theoretically be large because the requirement would cover many more sources. However, unless there are ways to effectively streamline BACT determinations and permitting for smaller sources (as discussed below), BACT would not appear to be an efficient regulatory approach for many other types of sources. We request comment on the potential overall benefit of applying the BACT requirement to GHG emissions, and how this potential benefit is distributed

[271] However, EPA notes that the BACT requirement does not require consideration of technologies that would fundamentally redefine a proposed source into a different type of source (e.g., BACT for a proposed coal-fired power plant need not reflect emission limitations based on building a gas-fired power plant instead). See, for example, *In re: Prairie State Generating Company*, PSD Appeal No. 05-05, slip op. at 19-37 (EAB 2006).

among categories of potentially regulated sources and modifications. Below, we discuss and ask for comment on possible tailoring of BACT for GHGs.

Finally, in considering the potential for emissions reductions from the PSD program, it is important to note that, historically, sources generally have taken action to avoid PSD rather than seeking a permit, where possible. Companies can reduce their PTE, for example, by artificially capping production or forgoing efficiency improvements. While these PSD avoidance strategies can sometimes reduce emissions (e.g., limiting operating hours or installing other controls to net out), they can sometimes result in forgone environmental benefits (e.g., postponing an efficiency project). These effects are very difficult to quantify. For example, the developer of a large apartment building that would be a major source for CO_2 might elect to provide electric space heat if it were determined that the direct and indirect costs of PSD made installation of gas heat uneconomical. From a lifecycle analysis standpoint, PSD could -- depending upon the source of the electricity -- lead to either a better or a worse outcome for overall emissions of GHGs. Similarly, because PSD is triggered based on increases over a past baseline, a source considering a potential modification may have an incentive to increase emissions (to the extent that can be done without a modification) for the 2-year period before the modification to artificially inflate the baseline. Similarly, in the electricity sector, a desire to avoid PSD review could be a disincentive for some projects to improve efficiency, because a small increase in utilization of the more-efficient EGU would raise CO_2 emissions sufficiently to trigger review. We solicit comments on the potential indirect effects, adverse or beneficial, that may arise from the incentive to avoid triggering PSD.

c. Administrative Considerations and Implications of Regulating Numerous Smaller Sources

The PSD program is designed to provide a detailed case-by-case review for the sources it covers, and that review is customized to account for the individual characteristics of each source and the air quality in the particular area where the source will be located. Although this case-by-case approach has effectively protected the environment from emissions increases of traditional criteria pollutants, there have been significant and broad-based concerns about PSD implementation over the years due to the program's complexity and the costs, uncertainty, and construction delays that can sometimes result from the PSD permitting process. Expanding the program by an order of magnitude through application of the 100/250-ton thresholds to GHGs, and requiring PSD permits for numerous smaller GHG sources and modifications not previously included in the program, would magnify these concerns. EPA is aware of serious concerns being expressed by sources and permitting authorities concerning the possible impacts of a PSD program for GHGs.

While the program would provide a process for reviewing and potentially reducing GHG emissions through the BACT requirement as it has done for other pollutants, we are concerned that without significant tailoring (and possibly even with significant tailoring), application of the existing PSD permitting program to these new smaller sources would be a very inefficient way to address the challenges of climate change. We ask for comment on how we should approach a determination of (1) whether

PSD permit requirements could be appropriate and effective for regulating GHGs from the sources that would be covered under the statutory thresholds, (2) whether PSD requirements could at least be effective for particular groups of sources (and if so, which ones), and (3) what tailoring of program requirements (options for which are described in more detail below) is necessary to maximize the program's effectiveness while minimizing administrative burden and permitting delays. We are particularly interested in how we might make such judgments in light of the limitations on our ability to quantify the costs and emissions reduction benefits of the PSD program, and whether there are specific examples or other data that would help us with such an analysis.

For example, if 100- and 250-ton thresholds were applied to GHGs, the BACT requirement would need to be newly implemented for numerous small sources and modifications that permitting authorities have little experience with permitting. It would also likely involve, for both large and small sources, consideration of new pollutants for which there are limited add-on control options available at this time. Thus, as with setting NSPS, a BACT determination for GHGs would likely involve decisions on how proposed installations of equipment and processes for a specific source category can be redesigned to make those sources more energy efficient while taking cost considerations into account. However, unlike NSPS, because BACT is typically determined on a case-by-case basis for each facility and changes as technology improves, these decisions would have to take into account case-specific factors and constantly evolving technical information[272]. Due to the more-than-tenfold increase in the number of PSD permits that would be required if the 100- and 250-ton thresholds were applied to GHGs, and the

[272] The NSPS program does take into account improvements in technology, but does so during the 8-year review of the NSPS under 111(b)(1)(B) rather than on a permit-by-permit basis.

potential complexity of those permitting decisions, state, local, federal, and tribal permitting authorities would likely face significant new costs and other administrative burdens in implementing the BACT requirement for GHGs. Large investments of resources would be required by permitting authorities, sources, EPA, and members of the public interested in commenting on these decisions. Also under this scenario, sources would likely face new costs, uncertainty, and delay in obtaining their permits to construct.

d. Definition of Regulated Pollutant for GHGs

We also note, as described above, that decisions on the definition of regulated pollutant for GHGs – whether GHGs would be regulated as individual gases or as a class – has implications for BACT determinations under the PSD program. If GHGs are regulated separately, it is possible that a control project for one GHG could trigger PSD for another (e.g., controlling methane in a way that increases CO_2). In addition, the economic and other impacts for BACT would need to be evaluated on a pollutant-by-pollutant basis. While regulating GHGs as a class would provide additional flexibility in this area, each BACT analysis would be more extensive because it would have to include combined consideration of all GHGs in the class. We ask for comment on the relative strengths and weaknesses of the various ways to define the regulated pollutant for GHGs as related to the BACT requirement.

e. Other PSD Program Requirements

Other parts of the CAA PSD provisions and EPA regulations that could be affected by bringing GHGs into the program include the requirement to evaluate, in consultation with the Federal Land Manager (FLM), impacts on Air Quality Related Values (AQRVs) in any affected "Class I area" (national parks, wilderness areas, etc.), and the need to conduct additional analysis of the proposed source's impacts on ambient air quality, climate and meteorology, terrain, soils and vegetation, and visibility, as provided for in section 165(e) of the Act. These requirements can result in adjustments to the permit (for example, permit conditions may be added if a FLM demonstrates to a permitting authority that additional mitigation is necessary to address the impacts of GHG emissions on the AQRVs of a Class I area). Due to the increase in number of permits, permitting authorities may have to make significant programmatic changes to deal with the increased workload to conduct these analytical requirements of the PSD program, and many additional applicants will have to devote resources to satisfying these requirements. In addition, given the uneven geographic distribution of new source growth, some permitting authorities may be required to conduct more permit analyses than others.

f. GHG NAAQS Nonattainment Scenario

If nonattainment NSR were triggered under a GHG NAAQS, the most significant requirement would be the LAER requirement. Because LAER does not allow consideration of costs, energy, and environmental impacts of the emissions reduction technology, the LAER requirement would have the potential to act as a strong technology forcing mechanism in GHG nonattainment areas. On the other hand, once a technology is demonstrated, this mechanism does not allow consideration of the costs, competitiveness effects, or other related factors associated with the new technology. As with PSD requirements, the application of LAER to numerous smaller sources nationwide would raise new issues on which we request comment. For example, with LAER, any demonstrated technology for reducing CO2 emissions, such as a new efficient furnace or boiler design, could become mandated as LAER for all future construction or modification involving furnaces or boilers. Manufacturers would have to supply technologies that could meet LAER or face regulatory barriers to the market, and could face a constantly changing regulatory level that may result in newly designed products being noncompliant shortly after, or even before, they are produced and sold. New and modified sources would be required to apply the new technology even if it is a very expensive technology that may not necessarily have been developed for widespread application at numerous smaller sources, and even if a relatively small emissions improvement came with significant additional cost. We request comment on how EPA should evaluate the LAER requirement under a NAAQS approach for GHGs. In particular, we ask for information about whether the relatively inflexible nature of the LAER requirement would lead to economic disruption for certain types of sources (and if so which ones), and whether the benefits of a NAAQS approach including LAER would warrant further evaluation and possible tailoring of LAER to address GHGs.

We also ask for comment on any other NSR program issues particular to a NAAQS approach, should EPA decide to establish a NAAQS for GHGs. Although we have not provided a comprehensive discussion of such issues, a number of questions arise that are particular to the NSR requirements that flow from a NAAQS approach. For example, if the entire country were designated nonattainment for GHGs, would the offset requirement function as a national cap-and-trade program for GHG emissions for all major sources? If so, how would such a program be administered, and would the numerous small sources described above be covered? Would the offset requirement argue for regulating GHGs as a group, rather than individually, to facilitate offset trading? What would be an appropriate offset ratio to ensure progress toward attainment? Similarly, for the air quality analysis requirements of PSD, how would a single source determine whether its contribution to nonattainment is significant? When must such a source mitigate its emissions impact, and what options are available to do so? Should EPA set a PSD increment for GHGs if a NAAQS is established? Are there additional issues of interest that we have not raised in this notice?

5. What Are the Possible Implications on Other Provisions of the Clean Air Act?

If PSD for GHGs applied to the same sources as a new market-oriented program to regulate GHGs under the Act, the interaction of the two programs would be a key issue. PSD would ensure that new and modified sources were built with the best available technology to minimize GHG emissions. A traditional argument for NSR is that it ensures that new sources are built with state-of-the-art technology that will reduce emissions throughout the lifetime of that source, which can be several decades. However if the market-oriented program is a cap-and-trade system with sufficiently stringent caps, PSD would not result in more stringent control of new GHG sources than the cap-and-trade system alone. In addition, the potential would exist for PSD to interfere with the efficient operation of the GHG cap-and-trade program. Although PSD would neither reduce nor increase the overall emission reductions achieved under the cap, it would force different choices about the stringency and location of controls than if control choices were based solely on market factors. Under this scenario, the result would be to increase costs without achieving additional GHG emissions reductions. For example, assume that a company undertakes a change that triggers PSD at a location where controls are expensive to retrofit but are required as BACT for that location. Without PSD, the company could have increased emissions and still complied with the cap by purchasing less expensive emissions reductions from another source, and the same total GHG emissions reductions would have been achieved. Notably, for GHGs, which have relatively uniform global concentrations, the location of GHG emissions does not matter to global climate impacts, so the policy reasons for the spatial component of PSD control requirement would not apply to GHG controls.

PSD program requirements also affect numerous CAA programs that require stationary source controls that may increase emissions of pollutants other than the pollutant targeted for control (i.e. “collateral increases”), such as the increased NOx emissions that result when a thermal oxidizer is installed to control VOC. Because there is no exemption from PSD requirements for such pollution control projects, the collateral increase must be reviewed, which can result in added costs and delay of those pollution control projects. Regulation of GHGs would exacerbate these concerns because the energy demands of many controls for criteria pollutants, HAP, and other pollutants have the potential to result in increased CO_2 emissions.

6. What Are Some Possible Tailoring Approaches to Address Administrative Concerns for GHG NSR?

The cost and potential broad applicability of PSD requirements raises questions about whether GHG regulation through PSD would be more effective in minimizing GHG increases if it operates as a broad program targeting numerous smaller sources and modifications, or as a narrow program targeting smaller numbers of large sources and modifications. We ask for comment on how these cost/benefit considerations for permitting small sources and modifications under PSD, as well as any other factors, should be considered in EPA's deliberations regarding the major source cutoffs and significance levels for GHGs as well as EPA's available legal authority in this area.

EPA believes that whether or not PSD is workable for GHGs may depend on our ability to craft the program to deal with the unique issues posed by GHG regulation. This section discusses several options, including:

- Reducing the potential universe of sources based on "potential to emit" approaches;
- Increasing the major source thresholds and significance levels for GHGs, to permanently restrict the program to larger sources;
- Phasing in the applicability of PSD for GHGs;
- Developing streamlined approaches to implementing the BACT requirement; and

- Issuing general permits for numerous similar sources.

The options are not necessarily exclusive. Many are complementary, and we note that some combination of these options may be most effective. We also ask for suggestions on additional tailoring options not described below, and more generally on which options, if any, present an appropriately balanced means of addressing the administrative concerns.

Before discussing each option in detail, we present an overarching legal discussion that lays out possible rationales for such flexibility. For at least one of the options identified (e.g., the option of adopting higher major source sizes than those contained in the Act), the principal legal constraint is the "plain meaning" of the applicable PSD provisions, such as the major source levels. Nonetheless, we have identified two legal doctrines that may provide EPA with discretion to tailor the PSD program to GHGs: absurd results and administrative necessity.

The Supreme Court has stated that the plain meaning of legislation is not conclusive "in the 'rare cases [in which] the literal application of a statute will produce a result demonstrably at odds with the intentions of the drafters' … [in which case] the intention of the drafters, rather than the strict language, controls." U.S. v. Ron Pair Enterprises, Inc., 489 U.S. 235, 242 (1989). To determine whether "the intentions of the drafters" differs from the result produced from "literal application" of the statutory provisions in question, the courts may examine whether there is a related statutory provision that conflicts, whether there is legislative history of the provisions in question that exposes what the legislature meant by those terms, and whether a literal application of the provisions produces a result that the courts characterize variously as absurd, futile, strange, or indeterminate. See, e.g., *id.*, Nixon v. Missouri Municipal League, 541 U.S. 125 (2004); United States v. American Trucking Association, Inc. 310 U.S. 534 (1940); Rector of Holy Trinity Church v. U.S., 143 U.S. 457 (1892).

Further, the administrative burdens that would result for the federal and state permitting authorities, as well as the sources, from a literal application of the PSD provisions give rise to consideration of whether EPA can craft relief from a strict interpretation based on the judicial doctrine of administrative necessity. In Alabama Power, the D.C. Circuit addressed various instances of claimed administrative burdens resulting from the application of the PSD statutory provisions and efforts by EPA to provide regulatory relief. Alabama Power Co. v. Costle, 636 F.2d at 357-60 (D.C. Cir. 1980). In a section of its opinion titled "Exemptions Born of Administrative Necessity," the Court stated,

> Certain limited grounds for the creation of exemptions are inherent in the administrative process, and their unavailability under a statutory scheme should not be presumed, save in the face of the most unambiguous demonstration of congressional intent to foreclose them.

Id. at 357. The Court identified several types of administrative relief. One is "[c]ategorical exemptions from the clear commands of a regulatory statute," which the court stated are "sometimes permitted," but emphasized that they "are not favored." *Id.* at 358. A second is "an administrative approach not explicitly provided in the statute," such as "streamlined agency approaches or procedures where the conventional course, typically case-by-case determinations, would, as a practical matter, prevent the agency from carrying out the mission assigned to it by Congress." *Id.* A third is a delay of deadlines upon "'a showing by [the agency] that publication of some of the guidelines by that date is infeasible.'" *Id.* at 359 (quoting NRDC v. Train, 510 F.2d 692, 712 (D.C. Cir. 1974). The Court indicated it would evaluate these choices based on the "administrative need to adjust to available resources … where the constraint was imposed …by a shortage of funds…, by a shortage of time, or of the technical personnel needed to administer a program." *Id.* at 358.

a. Potential-to-Emit: Reducing the Number of Sources Potentially Covered

Applicability of PSD is based in part on a source's "potential to emit" or PTE. The PTE concept also is used for applicability of nonattainment NSR, Title V, and the air toxics requirements of section 112. We discuss PTE in detail here, but the issues and questions we discuss in this section apply equally to these other programs. As noted above, PTE is defined as the maximum capacity of a source to emit any air pollutant under its physical and operational design. In the case of sources that are not operating for part of the year, the PTE for many types of sources counts the emissions that would be possible if those sources did emit year round.

EPA believes that an important threshold question is how to interpret "maximum capacity … to emit … under its physical and operational design" for commercial and residential buildings, and other types of source categories that might be subject to PSD and Title V solely due to GHG emissions. For example, in the case of a furnace at a residence, is it appropriate, in calculating the furnace's PTE, to assume that a homeowner would set the thermostat at a level that would require the furnace to operate continuously throughout the year? Even on a cold winter day, a furnace typically turns on and off throughout the day, and as the weather warms, the number of operating hours decreases until the weather warms to the point where the furnace is not needed at all and is shut off for an extended time.

The EPA has in a few instances provided guidance on PTE calculation methodologies to account for category-specific considerations. For example, we issued technical guidance for calculating PTE from grain elevators that took into account inherent limitations on the amount of grain that could be handled due to the fact that grain is only available for handling during a relatively short harvest period, and is further limited by the amount of grain capable of being grown (as represented by a record crop year adjusted for future increases in crop yield) on the land that would ever reasonably be served by the elevator.[273] We ask for comment on whether, for smaller GHG sources like these, there could be appropriate methodologies for defining PTE in ways that consider these common-sense limitations on a source's operation, but still reflect the maximum *capacity* to emit of a source.

Sources with PTE exceeding the major source threshold can become minor sources by taking legally and practically enforceable limits on their PTE, by, for example, agreeing to operate only part of the year, or only so many hours per day, or by employing control devices.[274] Many sources are able to avoid classification as "major" by taking such limits.

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[273] Calculating Potential to Emit (PTE) and Other Guidance for Grain Handling Facilities: November 14, 1995 memorandum from John S. Seitz, Director, U.S. EPA Office of Air Quality Planning and Standards, to EPA Regional Offices.

[274] Current regulatory language allows consideration of such limits in calculating PTE only if they are federally enforceable, but this definition was vacated or remanded in three separate cases – one for PSD/NSR (Chemical Manufacturers Assn v. EPA, No. 89-1514 (D.C. Cir. Sept. 15, 1995), one for Title V (Clean Air Implementation Project v. EPA, No. 96-1224 (D.C. Cir. June 28, 1996), and one for section 112

The estimates provided for potential new permits for GHG sources outlined in section VII.D.2 above are based on actual emissions. Were they based on PTE, and if year-round operation were assumed to represent PTE for all source categories, the estimates would likely be an order of magnitude higher (in the absence of actions to limit the scope of the programs). This emphasizes the significance of the interpretation of "potential to emit" for buildings and other categories not traditionally subject to PSD, as well as the importance of streamlined mechanisms for obtaining limits on PTE.

For traditional PSD and Title V permitting, the PTE limit is typically a source specific limit that is crafted in a facility's minor source permit and tailored to the source's individual circumstances. If it were necessary to create PTE limits for very large numbers of GHG-emitting sources nationwide, this would certainly require a more efficient approach than creating them through individual minor source permits. Not only would the sheer volume of permits and the process required for each one severely strain permitting authority resources, but some state and local agencies may lack the authority to establish minor source permit limits for non-NAAQS pollutants. In addition, while sources may not seek PTE limits for PSD until they have planned modifications that could otherwise trigger PSD, sources may seek PTE limits for Title V purposes as soon as the program is effective, meaning that the approach would need to deal with a large number of sources at essentially the same time.

We ask for comment on whether we should also therefore consider streamlined regulatory approaches for creating the legally and practically enforceable limits sources need without requiring a huge number of individual minor source permits. A possible

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(National Mining Association v. EPA, 59 F. 3d 1351 (D.C. Cir. 1995). EPA is developing a rule to respond to these cases and in the meantime is following a transition policy that does not require federal enforceability.

mechanism could involve adopting a regulation that sets forth operational restrictions that limit PTE for a broad class of sources. We may wish to consider adopting – or encouraging state permitting authorities to adopt – rules for numerous categories where we expect there to be large numbers of sources whose actual emissions are not major but who have major PTE (unless addressed through interpreting maximum capacity as described above). Such a rule could, for example, limit a source's natural gas usage to 1700 MM BTU (17,000 therms) per year, which would keep it below the 100 tpy cutoff for Title V.[275] Typically, the rule would also build in some operating margin so that the limit is not right at the major source cutoff. The rule would have to include recordkeeping and reporting, which would be simple here since fuel use is metered. This approach may be a streamlined effective way to limit PTE for many sources with fuel combustion equipment, provided they can agree to comply with the limits in the rule, even in an abnormally long, cold winter. We ask for comment on stakeholders' experience with limiting PTE by rule rather than through individual permits, possible considerations in tailoring this approach to GHG sources, and identification of categories that might benefit from the use of rules limiting PTE.

Finally, where the establishment of a rule-based PTE limit for an entire source category is not recommended or is infeasible, the EPA requests comment on whether general permitting approaches might be useful. A general permit is a permit that the permitting authority drafts one time, and then applies essentially identically (except for some source-specific identifying information) to each source of the appropriate type that

[275] Although the PSD cutoff may in some cases be 250 tpy, sources will generally adopt PTE limits below 100 tpy to avoid both PSD and Title V applicability where they have the option to do so. For this reason, this example uses a 100 tpy cutoff, though in some cases PTE limits are taken to stay below a 250 tpy cutoff.

requests coverage under the general permit. Similar to the type of rules limiting PTE described above, a general permit could also limit PTE by setting out the operational restrictions (e.g., fuel combusted per year) necessary to assure the GHG emissions stay below major source thresholds, and would also spell out records the source would have to keep to assure it met these restrictions. To be most useful, the permit would need to address large numbers of similar sources. This approach may also work well for many types of GHG sources as well. We request comment on the use of a general permit approach to limiting PTE, and whether it would offer additional benefit over the approach of establishing operational restrictions directly by rule.

b. Options for Setting Higher GHG Major Source Cutoffs and Significance Levels

If the EPA ultimately determines that subjecting numerous small sources and modifications to PSD is not an effective way to address GHG emissions, one possible option for tailoring the program would be to raise the major source cutoffs (e.g., raise the threshold only for GHGs as a class, or perhaps only for certain individual GHGs) and establish a significance level for GHGs at a level high enough to assure that the program applies to larger sources and modifications, but excludes smaller sources and modifications. Since the existing major source thresholds are set forth in the CAA itself, EPA would need to find the legal flexibility to raise these thresholds above 250 and 100 tons per year. We present for discussion below several policy and legal options for higher major source cutoffs and significance levels.

i. Higher GHG major source cutoffs – possible approaches and legal basis

Regardless of how PTE is calculated, the major source size threshold will be a critical consideration in tailoring the PSD program for GHGs. There are a number of factors one might consider in choosing an appropriate cutoff for GHGs and whether to establish the cutoff for individual gases such as CO_2 or for GHGs as a class. One conceptual approach might be to identify the number of sources and modifications affected by various cutoffs, calculate the costs and benefits of a PSD program for that universe of affected sources, and select a cutoff that optimizes the benefit-cost ratio. Unfortunately, we presently have the ability to quantify in dollar terms only a subset of the climate impacts identified by the IPCC. Also, we have very limited data on the number of sources expected at various major source cutoffs, and even more limited data on the number of modifications at various significance levels. More importantly, it is very difficult to project the future number of permits or the incremental impact of any additional GHG reductions that would result from the control technology decisions therein. For these reasons, EPA cannot quantitatively determine an optimal major source size or significance level.

We could, however, consider other means of setting levels. One example is an emissions scaling approach. This approach would compare the emissions of other existing NSR pollutants for sources that are major and would calculate the corresponding GHG emissions that the same source would emit. This would be an appropriate approach if the goal were to tailor PSD applicability for GHGs to cover a similar universe of source sizes and types to the universe now regulated for other pollutants. A second option would be to base the major source size on a scientific determination of a level below which an individual source would have a *de minimis* contribution to any particular adverse climate-related impact on a relevant health, societal, or environmental endpoint. Although it may be possible to generally estimate such a level, we are not currently aware of any scientific literature that establishes a specific numeric threshold below which GHG emissions are *de minimis*, either in terms of their impact on climate, or on these endpoints. By the same token, aside from an ability to use currently available models to project temperature effects, the Agency does not have the ability to project specific climatic impacts or endpoints resulting from individual sources. Alternatively, we could potentially choose a GHG major source size that is selected to harmonize with GHG cutoffs from other regulatory programs. For example, the DOE's 1605(b) program has a threshold of 10,000 metric tons of CO_2 -equivalent, California's AB32 regulation for mandatory reporting of GHGs has a threshold of 25,000 metric tons of CO_2-equivalent, and the Wisconsin emission inventory reporting requirements has a CO_2 threshold of 100,000 short tons. Notably, these examples are thresholds for reporting requirements only. PSD would involve much more than simply reporting emissions, so under a harmonizing approach we may need to evaluate whether it is feasible to require not only reporting, but also the other PSD elements for the sources that would be covered. We ask for comment on the range of approaches EPA could take in selecting a major source cutoff if we decide it is appropriate under existing legal authority, if available, to develop a higher cutoff for GHGs. In addition, we request data that may be useful for conducting necessary analysis to support such approaches.

A related issue to the establishment of the major source thresholds and significance levels for GHGs is the selection of the metric against which these levels are evaluated. Emissions of GHGs are typically expressed in a common metric, usually the metric called CO_2-equivalent, although the measure known as Carbon Equivalent (CE) is also used. The use of either metric allows the impact of emissions of different GHGs to be directly compared, as some gases have a higher global warming potential or GWP than others. Since both units are measured in weight – usually tons – either could be used for purposes of PSD applicability. The use of either metric has the advantage of linking emissions of a GHG directly to its ability to impact climate, appropriately regulating more potent GHGs more stringently. The use of CO_2-equivalent would solve the problem of leaving unreviewed significant GHG emissions of some chemicals, such as hydrofluorocarbons, but it would leave many small CO_2 sources with less climate impact still subject to PSD. However, the use of Carbon Equivalent (CE) addresses both concerns. The attached table demonstrates the possible effect of using CE in making PSD applicability decisions:

	GWP	Emissions equal to 250 tons CE
Carbon dioxide (CO_2)	1	917 tons
Methane (CH_4)	21	44 tons
Nitrous oxide (N_2O)	310	3 tons
Hydrofluorocarbon (HFC)-134a	1300	1410 **lbs**

As the table shows, it would take more CO_2 emissions to reach the major source size for CE. However. it would take substantially less of several other GHGs. Such an approach would likely result in fewer sources being added to the PSD program for GHGs in total. While more sources for several GHGs would be considered major, the major source population is, as noted above, dominated by CO_2, and there would be fewer sources classified as major due to CO_2 emissions. This approach arguably would regulate significant sources of potent GHG while also reducing the burden on relatively small sources of CO_2, focusing efforts on the sources with the most important climate impacts. EPA seeks comments on the potential use of the CE measure as the means to determine PSD applicability. Specifically we ask for comment on the appropriateness of the metric (considering that CO_2, rather than carbon, is the air pollutant), data regarding its effect on PSD applicability, and views concerning whether such an approach fits within the language of the CAA.

Whether, and the extent to which, EPA has flexibility to limit the application of the PSD permitting requirements (and, by extension, the nonattainment NSR permitting requirements if a NAAQS is set for GHGs) to sources that emit larger amounts of CO_2 and other GHGs than the 100/250 tpy thresholds depends on the interpretation of the key PSD definitional term, "major emitting facility." Under CAA section 165(a), the basic PSD applicability requirement is that a "major emitting facility" may not construct unless it has received a permit that covers specified requirements.[276] As defined by CAA section 169(1), a "major emitting facility" is defined to include (i) "any … stationary

[276] The requirement to obtain a permit applies to a source that commences construction after the effective date of the 1977 Clean Air Act Amendments (August 7, 1977), and that does so "in any area to which [the PSD provisions] appl[y]." All parts of the United States and its possessions are covered (see CAA sections 161, 302(d) and (q), and 110(a)(1)), but if EPA promulgates a NAAQS for GHGs and designates certain areas as nonattainment, then those areas would not be covered.

source[]" that emits or has the potential to emit 100 tpy or more of any air pollutant and that falls into one of 28 specified industrial source categories; and (ii) "any other source with the potential to emit 250 tons per year or more of any air pollutant. " However, the last sentence of this definition allows states to exempt "new or modified facilities which are nonprofit health or educational institutions" from the PSD program. EPA's regulations, promulgated in 1980 and revised several times since then, make clear that emissions count toward the 100/250 tpy thresholds only if they are "regulated NSR pollutant[s]" (e.g., 40 CFR 52.21(b)(1)(i)(a)), the specific meaning of which is discussed elsewhere in this notice.

Once GHGs are regulated, these PSD provisions, by their terms, would apply to sweep into the PSD program new sources that emit 100 or 250 tpy of CO_2 or other GHGs. As indicated above, the courts have held that the plain meaning of statutory provisions is generally controlling. Even so, we solicit comment on whether these PSD threshold requirements may present one of those rare cases in which congressional intent differs, based on the legislative history.

The legislative history indicates that Congress was aware of the range of stationary sources that emitted pollution and did not envision that PSD would cover the large numbers of smaller sources within that inventory**.** As the D.C. Circuit stated in Alabama Power, the seminal court decision regarding PSD that reviewed numerous challenges to EPA's initial set of PSD regulations,

> Congress's intention was to identify facilities which, due to their size, are *financially able* to bear the substantial regulatory costs imposed by the

PSD provisions and which, as a group, are *primarily responsible* for emissions of the deleterious pollutants that befoul our nation's air.

636 F.2d. 323, 353 (D.C. Cir. 1980) (emphasis added). In addition, Congress also sought to protect permitting authorities from undue administrative burdens. See S. Rep. 95-127 at 97; Alabama Power, 636 F.2d at 354.

One important indication that Congress viewed PSD as limited in scope may be found in information provided by EPA in 1976 and included in the Congressional Record**:** a comprehensive list of industrial and commercial source categories, which included the amounts of certain pollutants emitted by "typical" sources in those categories and the number of new plants in those categories constructed each year. 122 Cong. Rec. S 24548-50 (July 29, 1976) (statement of Sen. McClure). The pollutants included particulate matter (PM), sulfur dioxide (SO2), carbon monoxide (CO), and hydrocarbons. The two largest of these source categories consisted of **–**

- Small boilers, those that generate between 10 MMbtu/hr and 250 MMbtu/hr. EPA estimated that 1,446 new plants with boilers of this size were, at that time, constructed each year, and that the amount of PM emissions with controls from a "typical" such boiler were 53 tpy.
- *Very* small "boilers," those that generate between 0.3 MMBtu/hr and 10 MMBtu/hr. EPA estimated that 11,215 new plants with boilers of this size were, at that time, constructed each year, and that the amount PM emissions with controls would be 2 tpy.

The D.C. Circuit indicated, in Alabama Power, that Congress did not believe sources with boilers of these small sizes should be covered by PSD: "[With respect to] the heating plant operating in a large high school or in a small community college … [w]e have no reason to believe that Congress intended to define such obviously minor sources as 'major' for the purposes of the PSD provision."[277] 636 F.2d at 354. To support this proposition, the Court cited a statement in the Congressional Record by Sen. Bartlett arguing that the PSD provisions should not cover "[s]chool buildings, shopping malls, and similar-sized facilities with heating plants of 250 million BTUs." *Id.* at 354 (*citing* 122 Cong. Rec. S. 12775, 12812 (statement of Sen. Bartlett)). Yet, boilers of even this small size could well emit at least 250 tpy of CO2 and therefore could fall into PSD permitting requirements if the definition of "major emitting facility" is read to include emitters of CO_2 of that size or more.

Thus, it is clear that Congress's construct of PSD – specifically, the 100/250 tpy thresholds – was based on Congress's focus on conventional pollutants at that time and its understanding that sources emitting conventional pollutants above those levels should be subject to PSD, with its attendant cost burdens, both because such sources have the financial resources and because they have the responsibility to reduce their large share of the convention pollution problems. Limited administrative resources were also part of this equation. But the equation is scrambled when CO_2 is the pollutant because many smaller sources, with limited resources, and whose share of the GHG emissions problem is no greater than their share of the conventional pollution problem, get swept into PSD at those threshold levels. Further, administrative resources become greatly stretched. Juxtaposing the limited scope of the universe of PSD sources that Congress had in mind against the broad terms that Congress used in defining "major emitting facility," which

[277] Although Congress specifically authorized the States to exempt "nonprofit health or education institutions" from the definition of "major emitting facility," this statement by the D.C. Circuit should be taken as the Court's view that Congress did not design PSD to cover sources of the small size described.

determines PSD applicability, raises the question of whether a narrower interpretation of those terms may be permissible under various judicial doctrines.

We solicit comment on whether the case law cited above, concerning narrowing the application of statutory provisions in light of other indications of congressional intent or in light of administrative necessity, support interpreting the term, “major emitting facility” in a manner that is narrower than the literal meaning of the phrase, “any other source” in the case of sources that emit amounts of CO_2 that are more than 250 tpy but less than the levels discussed above.

ii. Modifications: Options and legal basis for higher GHG significance levels

Regarding the selection of a significance level for GHG emissions, we could follow a *de minimis* approach, as we have done in setting the existing PSD significance levels. We could base the significance level on the level below which an individual modification has a *de minimis* contribution to climate change. A scaling approach similar to that discussed above for the major source threshold is also an option for setting the significance level. We could set the significance level to a level of GHG emissions that corresponds to the same activity level as the significance levels for other pollutants, so as to roughly maintain the same permitting burden for GHGs as for “traditional” pollutants. We ask for comment on the merits of these approaches and invite suggestions on other approaches. We are also interested in specific information that would help us analyze how the selection of various significance levels would affect the number and types of modifications affected.

The legal rationale for establishing a significance level is found in the D.C. Circuit's Alabama Power decision, 636 F.2d at 405, where the Court authorized EPA to establish "a *de minimis* standard rationally designed to alleviate severe administrative burdens." The Court elaborated:

> A rational approach would consider the administrative burden with respect to each statutory context: what level of emission is *de minimis* for modification, what level *de minimis* for application of BACT. Concerning the application of BACT, a rational approach would consider whether the *de minimis* threshold should vary depending on the specific pollutant and the danger posed by increases in its emission. The Agency should look at the degree of administrative burden posed by enforcement at various *de minimis* threshold levels…. *It may…be relevant…that Congress made a judgment in the Act that new facilities emitting less than 100 or 250 tons per year are not sizeable enough to warrant PSD review.*

Id. (emphasis added). We believe that this approach entails broad discretion in fashioning a *de minimis* level, consistent with the overarching principle of obviating administrative burdens that are not commensurate with the contribution of the amount of emissions to the pollution problem. We consider the Court's emphasized statement to leave the door open to setting significance levels at the same level as the applicability threshold levels. We solicit comment on appropriate GHG significance levels, and on the relationship of significance levels to the GHG applicability thresholds discussed above.

c. Phase-In of PSD Permitting Requirements

Absent higher major source cutoffs and significance levels, it would be necessary to formulate a strategy for dealing with the tenfold increase in required permits that EPA projects permitting authorities will experience if GHGs become regulated for PSD purposes. Even with advance notice, an increase of this magnitude over a very short time could overwhelm permitting authorities. They would likely need to fund and hire new permit writers, and staff would need to develop expertise necessary to identify sources, review permits, assess control technology options for a new group of pollutants (and for a mix of familiar and unfamiliar source categories), and carry out the various procedural requirements necessary to issue permits. Sources would also face transition issues. Many new source owners and operators would need to become familiar with the PSD regulations, control technology options, and procedural requirements for many different types of equipment. If the transition were not effectively managed, an overwhelmed permit system would not be able to keep up with the demand for new pre-construction permits, and construction could be delayed on a large number of projects under this scenario.

The size of the increase in workload that must be accommodated and the potentially serious consequences of an overly abrupt transition demonstrate that a phase-in approach may have merit. Under one concept of a phase-in approach, EPA could phase-in PSD applicability beginning with the largest sources of GHGs and gradually include smaller sources. This could be accomplished by initially adopting a relatively high major source size and significance level, and then periodically lowering the level until the full coverage level is reached. We ask for comment on what an appropriate transition time would be, what the appropriate starting, middle, and end points would be in terms of coverage, and what requirements, if any, should be put into place for sources prior to their being phased in. For example, if the ultimate goal is to reach a 250 tpy major source cutoff, what would be the appropriate starting cutoff (e.g., 10,000 tpy) and how should it be determined? Would the phase-in need to be complete by a certain date, and if so how long should the phase-in take? Alternatively, could the phase-in of the smaller sources proceed by setting up periodic EPA evaluations of the administrative necessity for deferring applicability for such sources, and applying PSD only after we determine that it is feasible to do so? We also ask for comment on what activities occurring over this time we should consider in structuring a phase-in.

As noted elsewhere, in its broad review of the initial PSD program promulgated under the 1977 Clean Air Act Amendments, the D.C. Circuit set out a range of mechanisms through which an agency can, at least under "limited" circumstances, provide relief on grounds of "administrative necessity" from even clear statutory mandates, as long as those mandates do not unambiguously foreclose such relief. Alabama Power, 636 F.2d at 357. The Court noted that an agency could establish the need for such relief based on "a shortage of funds[,]… time, or… technical personnel." *Id*. at 358.

As described above, the large number of sources that would become subject to the PSD requirements at the 100/250 tpy levels would strain the administrative resources of the State permitting authorities and perhaps also of the EPA regional offices that issue

PSD permits. Each of the constraints noted by the Court in Alabama Power – funds, time, and technical personnel – would arise.

Elsewhere in this notice, we solicit comment on whether "administrative necessity" authorizes EPA to exempt categories of smaller GHG emitters. Here, we solicit comment on phasing-in the applicability of the permit program over a multi-year period, with successively smaller sources becoming subject. This method could allow an orderly ramp-up in funding and in essential human capital. Under such an approach, we also seek comment on whether it would be necessary to set a firm schedule for phase-in, or whether it is sufficient for the agency to select a future date to assess the level of program coverage and the associated administrative burden, and determine at that time whether it is appropriate to add them to the program, and if not, to set an additional future date to revisit the issue. We request information that would help us determine the appropriate timeframe for such assessments, including the current and anticipated state resources for processing PSD permits, including numbers of permitting personnel, and the time period and person-hours needed to issue a typical permit.

d. Streamlining Determinations of Required Controls

As previously noted, one of the most significant aspects of the PSD program for GHGs is the BACT requirement. While permitting authorities are accustomed to making BACT determinations on a case-by-case basis for major sources and modifications under the current PSD program, BACT for GHGs (particularly CO2) presents significant additional permitting challenges. The primary challenge is the dramatic increase in the number of sources and modifications that under the 100/250-ton thresholds would be subject to BACT review and the new source categories that would be brought into the PSD program, which could exceed the capacity of the permitting system and have negative effects described above in section VII.D.4. An additional challenge stems from the fact that for some GHG-emitting activities, primarily CO2 from combustion sources, permitting authorities will need to look at alternative approaches to determining BACT such as setting efficiency targets, if add-on controls are not viewed as adequately demonstrated. While there is much information available on efficiency for some of the various kinds of equipment used by these newly applicable sources, permit engineers will need to understand this information for a very wide range of source categories.

This section seeks comment on approaches for streamlining the BACT process for many new smaller sources that could be brought into the PSD program based on their GHG emissions. Under PSD, BACT is a case-by-case decision that reflects the state-of-the-art demonstrated control technology at the time of the permit action. Thus, BACT changes over time and requires continual updating. Determining BACT is also a decision that affords permitting authorities flexibility to consider a range of case-specific factors such as cost, energy, and environmental impacts. However, full case-by-case consideration of those factors requires significant data and analysis in order for permitting authorities to arrive at a permitting decision that is appropriate for each individual source or modification

EPA is interested in whether there would be ways to move from a PSD permit system in which BACT limits are set on an individual case-by-case basis to a system in which BACT determinations could be made for common types of equipment and sources, and those determinations could be applied to individual permits with little to no additional tailoring or analysis. EPA has previously introduced this concept, known as "presumptive BACT", as an aid to streamlining permitting for desulfurization projects at refineries as well as in other instances,[278] and some state permitting authorities have adopted similar approaches in their air permitting programs.[279] Based on our understanding of the types of sources that will become subject to PSD if GHGs are regulated with a major source size of 250 tpy of emissions, we believe the presumptive BACT process could offer significant streamlining benefits. These benefits arise because many of these smaller sources will likely have very similar emissions producing equipment, and there will be little variation across sources with respect to the cost, energy, and environmental considerations in the BACT decision.

While the CAA states that PSD permits shall be issued with BACT determinations made for each pollutant on a "on case-by-case basis," the court in Alabama Power recognized that exceptions may be appropriate where "*case-by-case determinations*, would, as a practical matter, prevent the agency from carrying out the mission assigned to it by Congress." 636 F.2d at 358 (emphasis added). The court recognized that such streamlining measures may be needed when time or personnel constraints or other practical considerations "would make it impossible for the agency to carry out its mandate." See *id.* at 359. Given the more-than-tenfold increase in new sources that would likely be brought into the PSD program once GHGs are regulated and

[278] See January 19, 2001 memo from John S. Seitz, Director, Office of Air Quality Planning and Standards to the Regional Air Division Directors entitled, "BACT and LAER for Emissions of Nitrogen Oxides and Volatile Organic Compounds at Tier 2/Gasoline Sulfur Refinery Projects.

[279] For example, Wyoming has a minor source permitting program that includes a BACT analysis, and they use a presumptive BACT process for issuing minor source permits to a particular source category – oil and gas production facilities. See Permitting Guidance for Oil and Gas Production Facilities, Wyoming Dept. of Environmental Quality, Air Quality Division (August 2007 revision).

the other challenges described above, maintaining a traditional PSD permitting program with individual case-by-case BACT determinations may be impractical, warranting streamlined regulatory approaches as allowed under the Act. A presumptive BACT permitting program would allow EPA, state and local permitting authorities to carry out the PSD program in a timely and efficient manner necessary to promote (rather than hinder) control of GHG emissions from the many new, small source categories that would be required to have PSD permits based on their GHG emissions, while still preserving opportunities for public participation.

In considering a change from case-by-case BACT determinations to a presumptive BACT process for some specific source categories within the PSD program, EPA is considering how such presumptive BACT limits should be established and used, and what provisions in the CAA would set requirements or limits on their establishment and use. In particular, EPA recognizes the statutory requirement to set BACT limits on a case-by-case basis after taking into account site-specific energy, economic, and environmental impacts (otherwise known as collateral impacts). One option would be to allow permitting authorities to adjust any BACT limit that was based on presumptive BACT, as necessary, upon identifying significant collateral impacts applicable to a specific source. EPA also recognizes the requirement to subject proposed PSD permits, and the BACT limits contained within them, to public notice and comment before such permits become final. A presumptive BACT program could be designed to establish presumptive emissions limits for a particular category of sources through guidance that would be issued only after public notice and comment procedures. Another approach could be to allow presumptive BACT limits in each permit to become final only if public comments fail to establish that significant case-specific energy, economic, and/or environmental impacts require adjustment of the presumed limit for that particular source.

In addition, while case-by-case BACT determinations allow for the continual evolution of BACT requirements over time (as controls applied in prior permits are considered in each subsequent case-by-case BACT determination), EPA recognizes that application of presumptive BACT to a category of sources over many permitting decisions may somewhat diminish PSD's incentives for improved technology. EPA is interested in options that would help maintain advances in control technologies, such as a requirement to update and/or strengthen the presumptive BACT at set intervals (such as after 3 years). EPA seeks comment on all aspects of the use of presumptive BACT limits within the PSD program, including EPA's authority to do so, whether there is need for and value to such an approach, and suggestions for how such limits could be established, updated, and used consistent with the requirements of the CAA.

The central component of a presumptive BACT approach would be the recurring technical determination, subject to notice and comment, of the presumptive BACT levels for various categories. Because of the limited data we currently have about the number and types of sources that would become subject to the BACT requirement for GHGs, we cannot at this time predict how many or which source categories might benefit from such an approach if we opt to pursue it. We seek comment on the basis we could use in setting the presumptive BACT level. Considerable work will be needed to determine what options exist for controlling GHG emissions from these categories of smaller sources and the various emitting equipment they use. Even if a determination is made that add-on controls for CO_2 from combustion sources are adequately demonstrated, it is unlikely that the application of these controls would be cost-effective at these small sources in the relatively near future. Thus the focus of presumptive BACT for CO_2 would likely be on energy efficiency standards for the installed equipment.

While PSD permitting staff generally would not possess specialized knowledge in the area of energy efficiency for categories of small sources, there is experience within EPA and other agencies that could help inform the establishment of presumptive BACT. Both EPA and DOE, for example, have extensive experience in deploying cost effective technologies and practices to reduce greenhouse gases from a wide range of emissions sources in support of the President's GHG intensity goal. For example the Energy Star program promotes efficient technologies through a labeling program that establishes performance-based specifications for determining the most efficient products in a particular category, which then qualify for the Energy Star label. To develop these specifications, EPA and DOE use a systematic process that relies on rigorous market, engineering, and pollution savings analyses as well as input from stakeholders. While Energy Star specifications generally cover electrical appliances or fuel combusting appliances that would be smaller than those triggering the BACT requirement, the types of analyses conducted for Energy Star could inform a the presumptive BACT process. In addition, DOE's Energy Efficiency and Renewable Energy program sets standards for several types of equipment, some of which may be affected by the BACT requirement if GHGs are regulated, including furnaces, boilers, and water heaters. The DOE standards are similar to the concept of presumptive BACT in that they take cost into consideration and are updated over time.[280] They also take into account effects on competitiveness among equipment manufacturers, which could be a significant concern if left unaddressed in determining presumptive BACT. We ask for comment on whether these or other similar programs could serve as a basis for the setting of presumptive BACT where applicable.

Regarding LAER, we note that, as previously discussed, if a NAAQS were established for GHG at levels lower than current concentrations, the relevant technology requirement would be LAER, not BACT. We ask for comment on whether the presumptive BACT approach would have utility for LAER and whether the particular statutory language of the LAER requirement would allow a presumptive approach under the same legal principles laid out for BACT.

Finally, while presumptive BACT or LAER may have the potential to help address the problem of numerous small but similar types of sources, it is likely of less value in making BACT or LAER determinations at the types of large sources that have generally been subject to PSD for traditional pollutants. This is because there is generally less similarity among these traditional sources. Nonetheless, as noted above, there may be numerous modifications that will be newly subject to PSD for GHGs at such sources, and there may also be issues unique to establishing control technology requirements for GHGs that do not presently exist for such sources. We ask for comment on whether there are issues at traditional PSD major sources that arise for GHGs and that would not be addressed by a presumptive BACT approach. If so, we ask for comment on additional options for tailoring the BACT requirement to address these issues.

[280] See, e.g., 42 U.S.C. 6295(o).

e. General Permits for Streamlined Permitting of Numerous Similar Sources

An approach closely linked with the presumptive BACT concept is the concept of a general permit for PSD. A general permit is a permit that the permitting authority drafts one time, and then applies essentially identically (except for some source specific identifying information) to each source of the appropriate type that requests coverage under the general permit. Congress expressly codified the concept of general permits when it enacted the Title V program (discussed below) and states have been using general permits and similar process for years in their own permit programs, particularly for minor source NSR[281] and operating permits. Due to the case-by-case nature of PSD permitting for "traditional" major sources and the differences among individual PSD sources, there has not been much interest or activity in general permitting for PSD. However, if one or more GHGs (particularly CO_2) become regulated pollutants, this approach merits strong consideration due to the large number of the sources that EPA expects will become newly subject to PSD for their GHG emissions and the similar characteristics of many of these sources.

Although there is no provision in the CAA that expressly authorizes the use of general permits in the PSD program, the D.C. Circuit, in the Alabama Power case described above, recognized that "[c]onsiderations of administrative necessity may be a basis for finding implied authority for an administrative approach not explicitly provided in the statute" and expressly identified general permits as an alternative to the exemptions that were at issue in that case. See 636 F.2d at 360. Further, courts have recognized

[281] The minor NSR is a NAAQS-based program for review of minor sources that is distinct from the PSD program. It is not discussed here.

EPA's authority to use general permits under section 402 of the Clean Water Act without an express provision authorizing such general permits. Environmental Defense Center v. EPA, 344 F.3d 832, 853 (9th Cir. 2003) ("General permitting has long been recognized as a lawful means of authorizing discharges.") (citing NRDC v. Costle, 568 F.2d 1369, 1381 (D.C. Cir. 1977)); NRDC v. Train, 396 F. Supp. 1393, 1402 (D.D.C. 1975) (EPA has "substantial discretion to use administrative devices, such as area permits, to make EPA's burden manageable.").

In considering the use of general permits within the PSD program, EPA is considering how such general permits would be established and used, and what provisions in the CAA might limit their establishment and use. One consideration in establishing PSD general permits is the requirement in CAA section 165(a)(2) that permits be issued after "a public hearing has been held with opportunity for interested persons including representatives of the Administrator to appear and submit written or oral presentations." One possible approach for fulfilling the public participation requirement is the approach followed for Title V general permits in 40 CFR 70.6(d), which provide that permitting authorities may establish general permits after following notice and comment procedures required under 40 CFR 70.7(h) and then grant a source's request to operate under a general permit without repeating the public participation procedures. Other considerations for establishing general permits under the PSD program include determining BACT on a case-by-case basis (as discussed in the previous section), and the other requirements referred to earlier in this section concerning the evaluation of impacts on AQRVs in Class I areas and the analysis of air quality and other potential impacts under CAA section 165(e).

EPA seeks comment on the use of general permits within the PSD program, including both EPA's authority to do so and suggestions for how general permits would be established and used consistent with the requirements of the CAA and identification of source categories that could benefit from such an approach. We also ask for comment on whether a general permit program approach could also work for nonattainment NSR in the event the EPA promulgates a NAAQS for GHGs and designates areas as nonattainment.

f. Coordinating Timing of PSD Streamlining with GHG Regulation under the Act

Regardless of how EPA might tailor the NSR program for GHGs, the timing of these approaches must be coordinated with other GHG actions under the CAA. As described above, the applicability of PSD is tied to whether a pollutant is subject to a control program under the Act. EPA strongly believes that we should be prepared the first time we regulate one or more GHGs under any part of the CAA to explain our approach to permitting, including full consideration of the ideas presented above for responding to the PSD implementation challenges. Coordination of the timing of tailoring strategies for PSD or nonattainment NSR to match with the effective date of the first GHG regulation is necessary to minimize confusion on the part of sources, permitting authorities, and the public, to provide for as effective a transition as possible, and to ensure that the strategies intended to avoid problems can be in place in time to prevent those problems. We seek comment on timing issues in general, and particularly on the coordination of the timing of permitting requirements with the timing of GHG regulation under other parts of the Act.

F. Title V Operating Permits Program

1. What Are the Clean Air Act Requirements Describing the Operating Permits Program?

The Title V operating permits program was enacted in 1990 to improve sources' compliance with the requirements of the CAA.[282] In summary, it provides for facility operating permits that consolidate all Act requirements into a single document, provides for review of these documents by EPA, States, and the public, and requires permit holders to track, report, and certify annually to their compliance status with respect to their permit requirements. Through these measures, it is more likely that compliance status will be known, any noncompliance will be discovered and corrected, and emissions reductions will result. Title V generally does not add new substantive requirements for pollution control, but it does require that each permit contain all a facility's "applicable requirements" under the Act, and that certain procedural requirements be followed, especially with respect to compliance with these requirements. "Applicable requirements" for Title V purposes generally include all stationary source requirements, but mobile source requirements are excluded.

[282] The operating permits program requirements are contained in title V of the CAA, and are codified in EPA regulations at 40 CFR parts 70 and 71.

Presently there are generally not any applicable requirements for control of GHGs that would be included in Title V permits, but regulation of GHGs under any of the approaches described above, including PSD, could give rise to applicable requirements that would be included. Even if a particular source emitting 100 tpy of a GHG is not subject to GHG regulations that are "applicable requirements," under a literal reading of Title V, the Title V permit for that source must include any other applicable requirements for other pollutants. For example, while a 100 tpy CO_2 source would usually have relatively small criteria pollutant emissions that would not by themselves have subjected the source to title V, once subjected to title V for CO_2 emissions, the source would then need to include any SIP rules (e.g., generally applicable opacity limitations that exist in several SIPs) that apply to the source.

When a source becomes subject to Title V, it must apply for a permit within one year of the date it became subject.[283] The application must include identifying information, description of emissions and other information necessary to determine applicability of CAA requirements, identification and certification of the source's compliance status with these requirements (including a schedule to come into compliance for any requirements for which the source is currently out of compliance), a statement of the methods for determining compliance, and other information. The permitting authority then uses this information to issue the source a permit to operate, as appropriate. A Title V source may not operate without a permit, except that if it has submitted a complete application, it can operate under an "application shield" while awaiting issuance of its permit.

[283] The deadline may be earlier if the permitting authority (usually an approved state or local air pollution control agency, but in some cases the EPA) sets an earlier date.

Title V permits must contain the following main elements: (1) emissions standards to assure compliance with all applicable requirements; (2) a duration of no more than 5 years, after which the permit must be renewed; (3) monitoring, recordkeeping, and reporting requirements necessary to assure compliance, including a semiannual report of all required monitoring and a prompt report of each deviation from a permit term; (4) provisions for payment of permit fees as established by the permitting authority such that total fees collected are adequate to cover the costs of running the program; and (5) a requirement for an annual compliance certification by a responsible official at the source. An additional specific monitoring requirement, compliance assurance monitoring (CAM), also applies to some emissions units operating at major sources with Title V permits.[284] The CAM rule requires source owners to design and conduct monitoring of the operation of add-on control devices used to control emissions from moderately large emissions units. Source owners use the monitoring data to evaluate, verify, and certify the compliance status for applicable emissions limits.[285] The CAM rule is implemented in conjunction with the schedule of the operating permits program.

While these are the main elements relevant to a discussion of GHGs, there are numerous other permit content requirements and optional elements, as set forth in the Title V implementing regulations at 40 CFR 70.6. One of these optional elements is of particular interest when considering the implications of GHG permitting: the provisions for general permits, which, as discussed in more detail below, can allow for more streamlined permitting of numerous similar sources.

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[284] Specifically, CAM applies to units with add-on control devices whose pre-control emissions exceed the applicable major source threshold for the regulated pollutant.
[285] CAM requirements are codified in 40 CFR part 64.

In addition to the permit content requirements, there are procedural requirements that the permitting authority must follow in issuing Title V permits, including (1) determining and notifying the applicant that its application is complete; (2) public notice and a 30-day public comment period on the draft permit, as well as the opportunity for a public hearing; (3) notice to EPA and affected states, and (4) preparing and providing to anyone who requests it a statement of the legal and factual basis of the draft permit. The permitting authority must take final action on permit applications within 18 months of receipt. EPA also has 45 days from receipt of a proposed permit to object to its issuance, and citizens have 60 days to petition EPA to object. Permits may also need to be revised or reopened if new requirements come into effect or if the source makes changes that conflict with, or necessitate changes to, the current permit. Permit revisions and reopenings follow procedural requirements which vary depending on the nature of the necessary changes to the permit.

2. What Sources Would Be Affected If GHGs Were Regulated under Title V?

Title V requires permitting for several types of sources subject to CAA requirements including all sources that are required to have PSD permits. However, it also applies to all sources that emit or have the potential to emit 100 tpy of an air pollutant.[286] As discussed above for the PSD program, the addition of GHG sources to the program would trigger permitting requirements for numerous sources that are not

[286] Other sources required to obtain Title V permits are "affected sources" under the acid rain program, and sources subject to NSPS or MACT standards (though non-major sources under these programs can be exempted by rule). It does not apply to mobile sources.

currently subject to Title V because their emissions of other pollutants are too small. The Title V cutoff would bring in even more sources than PSD because the 100 tpy (rather than 250 tpy) cutoff applies to all source categories, not just the ones specified in the Act's PSD provisions.

Using available data, which we acknowledge are limited, and engineering judgment in a manner similar to what was done for PSD, EPA estimates that more than 550,000 additional sources would require Title V permits, as compared to the current universe of about 15,000-16,000 Title V sources. If actually implemented, this would be more than a tenfold increase, and many of the newly subject sources would be in categories not traditionally regulated by Title V, such as large residential and commercial buildings. However, as described below, EPA believes that, if appropriate, there may be grounds to exclude most of these sources from Title V coverage, either temporarily or permanently, under legal theories similar to those for PSD.

The CAM requirement also applies to major sources that require Title V permits, meaning that a number of smaller sources are potentially newly subject to CAM as well. Under the current CAM requirements, applicability is limited to the monitoring of add-on control devices (e.g., scrubbers, ESPs). Presently there are few known add-on control devices for CO_2, and for many smaller sources, it is unlikely that there will be cost effective add-on controls for CO_2 for many years. Thus, we generally expect source owners to comply with any applicable GHG limits through the use of improved energy efficiency and other process operational changes rather than the use of add-on emissions reduction devices. As a result, even with the large number of sources that will exceed the applicability cutoffs, the CAM rule will have very limited application for sources subject to GHG rules. We ask for comment on this assessment of CAM applicability, and whether there may be CAM impacts that we have not described here.

As an additional note, if GHGs were regulated under section 112 authority, Title V could apply at an even smaller threshold. This consideration adds to the list of difficulties with using section 112 to regulate GHGs that were identified in section VII.C. Although HAPs are excluded from the definition of "regulated NSR pollutant," Title V explicitly includes major sources as defined in section 112 on the list of sources required to obtain an operating permit. While minor sources of HAP can be excluded by rule, major sources of HAP cannot. For HAPs, the major source cutoffs are (as noted previously) 25 tons for any combination of HAPs, and 10 tons for any single HAP. Thus, if GHGs were regulated as HAPs, a 10 ton CO_2 source would require an operating permit under Title V. Under this approach, the number of new Title V sources would easily number in the millions absent a means to limit PTE. In addition the major source definition under section 112 does not exclude fugitive emissions, as it does under PSD for unlisted categories. Thus, if GHGs were designated as HAPs, an uncertain number of additional new kinds of sources (e.g., agriculture, mining), would become newly subject to Title V due to fugitive emissions of GHGs. We ask for comment on whether there are factors EPA should consider in its description of the universe of potentially affected sources.

3. What Are the Key Milestones and Implementation Timeline if Title V Were Applicable for GHGs?

Under an interpretation of the Act parallel to that for PSD, Title V would become applicable for GHGs as soon as GHGs become subject to any actual control requirement. This timing is perhaps even more important for Title V than for PSD because of the potential for an extremely large number of new sources (unless EPA administratively reduced coverage) combined with the fact that Title V applications would all be due at the same time (unless a phase-in approach were adopted). This is because Title V requires permit applications within one year of a source becoming subject to the program, in contrast to the PSD program, where permitting authorities would receive applications over time as sources construct or modify.

Permitting authorities generally must act on Title V applications within 18 months. However, Congress addressed the burden imposed by the initial influx of (what turned out to be less than 20,000) initial Title V permits when it enacted Title V in 1990 by providing for a 3-year phased permit issuance timeline. Although the initial phase-in period is over, we discuss below the possibility of interpreting Title V provisions to authorize a phase-in period for GHG sources becoming newly subject to Title V as well. We ask for comment on whether there are factors EPA should consider in its description of these timelines.

4. What Are Possible Cost and Emission Impacts of Title V for GHGs?

Title V generally does not impose additional applicable requirements on a source. However, sources, permitting authorities, EPA, and the public (to the extent that they participate in the permitting process) all may incur administrative burden due to numerous activities associated with applying for, reviewing, commenting on, and complying with Title V permits. There are significant challenges that would arise if GHG sources become subject to Title V. The sheer volume of new permits would heavily strain the resources of state and local Title V programs. These programs may have to tailor their fee requirements or other program elements to address the strain caused by the influx of numerous smaller sources, even if the permits for each individual source are relatively straightforward. Many new types of sources would need to understand and comply with a new and unfamiliar program. Even under streamlined approaches like general permits (discussed below), there would be administrative burden imposed as sources would have to determine whether they are covered and, if so, would need to submit annual reports and certifications. EPA would see additional burden as well, both because we are the permitting authority in some areas and because we would probably see an increase in the number of Title V petitions. Because Title V does not create new applicable requirements, the new costs of Title V would be mainly attributable to administrative burden. Nonetheless, this overall administrative burden is likely to be unreasonable unless EPA reduces the number of covered sources as discussed below.

Title V of the CAA also contains a self-funding mechanism requiring that permitting authorities collect permit fees adequate to support the costs of running a Title V program. Title V fees must be used solely to run the permit program. For GHGs, the possibility of a huge influx of smaller sources raises questions about how permitting authorities should adjust their fee schedules to ensure that they have adequate resources to permit these sources without causing undue financial hardship to the sources. The most common approach, a cost per ton fee that is equal for all pollutants, would likely result in excessive costs to GHG-emitting sources because of the large mass emissions of GHGs compared to other pollutants. This is particularly true for the universe of small sources brought into Title V solely for their GHG emissions, because those permits are expected to be relatively simple and may even be addressed through general permits (which would not require as many resources or as high a fee). Although it may be permissible for permitting authorities to adopt lower fees specifically for GHGs, they would have to assess the new resources needed for permitting these sources and determine some basis for an appropriate fee and a workable mechanism for collecting it.

As noted above, the benefits of Title V stem primarily from the way its various provisions contribute to improved compliance with CAA requirements. However, for the particular sources that would be added to the program solely due to their GHG emissions, it is unclear whether there would be much benefit from these provisions given the small size of most of these new sources, the uniform design and operation of many of their emissions points, the anticipated lack of add-on control devices, and the relatively small number of applicable requirements that would be included in the permit. We ask for comment on the expected overall costs and benefits of running a Title V program for small GHG sources and for larger GHG sources (e.g., those emitting more than 10,000 tons per year).

5. What Possible Implications Would Use of this Authority for GHGs Have for Other CAA Programs?

Because Title V is designed to work in concert with other CAA requirements and is self-funding, we have not identified any impacts it would have on other programs.

6. What Are Possible Tailoring Approaches to Address Administrative Concerns for Title V for GHGs?

As we did in section VII.D regarding NSR, we present here for comment some possible tailoring options to address concerns about implementing Title V for GHGs. As was previously noted for NSR, we must consider how the Act's language may constrain these options. Nonetheless, we see at least two possible legal theories for reducing administrative concerns through limiting the scope of coverage of Title V that would otherwise result from regulating GHGs. First, case law indicates that in rare cases, the courts will interpret or apply statutory provisions in a manner other than what is indicated by their plain meaning. Courts will do so when Congress' intent differs from the plain meaning, as indicated by other statutory provisions, legislative history, or the absurd, futile, strange, or indeterminate results produced by literal application. Second, the administrative burden of literal application of the Title V provisions may also provide a basis for EPA, based on the judicial doctrine of administrative necessity, to craft relief in the form of narrowed source coverage, exemptions, streamlined approaches or procedures, or a delay of deadlines. Some specific options are discussed in the remainder of this section, and we invite comment on these and other suggested approaches.

a. Potential for Higher Major Source Cutoffs

As discussed above in section VII.A.5, Title V applies to several types of sources under the Act, including, among others, all PSD sources, as well as 100 tpy sources that are not subject to PSD. In section VII.D, we described the reasons why a higher major source cutoff for PSD might make sense to improve the effectiveness of the program by focusing resources away from numerous small sources for which the environmental benefits gained from permitting may not justify the associated administrative burdens. We believe such an approach might be even more important for Title V because many small sources that could become subject to the program solely because of their GHG emissions may have few or no applicable requirements. Unless GHG emissions from these small sources are regulated elsewhere under the Act, the only GHG-related applicable requirements for these sources would come from PSD permitting. Thus, if EPA adopts a higher major source size for PSD, it would arguably be incongruous to require 100 tpy GHG sources to obtain permits under Title V. In that case, adopting a higher applicability threshold for GHGs under Title V in parallel with, and at the same level as for PSD, would make even more sense. Similarly, if EPA were to regulate GHGs for certain source categories under CAA section 111 or 112, and were to include size cutoffs in those regulations, then it could make sense for the size-cutoffs for Title V purposes to reflect the cutoffs for those source categories under those regulations. Indeed, it could make sense to apply Title V only to those sources of GHGs that are themselves subject to regulation for GHG emissions.

We have found several indications of congressional intent that could serve as a basis for interpreting the Title V applicability provisions to implement the above-described size-cutoffs or other limitations, instead of interpreting them literally. First, other provisions in Title V and the legislative history indicate that the purpose of Title V is to promote compliance and facilitate enforcement by gathering into one document the requirements that apply to a particular source. *See* section 504(a) (each Title V permit must contain terms "necessary to assure compliance with applicable requirements" of the CAA), H.R. Rep. No. 101-490, at 351 (1990) ("It should be emphasized that the operating permit to be issued under this title is intended by the Administration to be the single document or source of all of the requirements under the Act applicable to the source."). Limiting the applicability of Title V to sources that emit GHGs in the same quantity as sources that would be subject to GHG limits under PSD (or other CAA requirements) for GHGs -- and excluding sources that emit GHGs in lower quantities and therefore are not subject to CAA requirements for GHGs – would be consistent with that purpose. Second, the legislative history of Title V indicates that Congress expected the provisions to apply to a much smaller set of sources than would become subject at 100 tpy GHG levels. *See* S. Rep. 101-228, at 353 ("[T]he additional workload in managing the air pollution permit system is estimated to be roughly comparable to the burden that States and EPA have successfully managed under the Clean Water Act[,]" under which "some 70,000 sources receive permits, including more than 16,000 major sources").

We ask for comment on whether we should consider higher GHG applicability cutoffs for Title V, what the appropriate cutoffs might be, and whether there are additional policy reasons and legal justifications for doing so or concerns about such an approach.

b. Potential for Phase-In of Title V Requirements

Due to the severe administrative burden that would result if hundreds of thousands of sources were all to become subject to Title V at the same time, as could be the case if EPA regulates GHGs elsewhere under the Act, and because many of the sources could become subject before the development of any stationary source controls for GHGs, it may make sense to defer Title V applicability for GHG sources that are subject to Title V solely due to GHG emissions. One deferral approach would be to defer Title V for such sources until such time as they become subject to applicable requirements for GHGs. Alternatively, it may make sense to phase in Title V applicability with the largest sources applying soonest, similar to what was discussed above for PSD permitting.

Legal support for some type of deferral may be found in the case law, described above, that identifies deferral as one of the tools in the “administrative necessity” toolbox. In the case of Title V, deferral may find further legal support by reference to provisions of Title V itself: Congress addressed the burden imposed by the initial influx of tens of thousands of Title V permits when it originally enacted Title V in 1990 by providing for a 3-year phased permit issuance timeline.[287] A similar phased approach may have even greater merit here due to the even greater number of permits. We ask for comment on the legal and policy arguments for or against a phase-in approach, and request suggestions for workable permit application and issuance timelines for Title V permits for small GHG sources.

[287] CAA section 503(c)

c. General Permits

The use of general permits is an additional option for addressing the potentially large numbers of GHG sources that could become subject to Title V. While general permits would not completely eliminate the resource burden, and may not work for every type of source, they clearly offer an option for meeting the Title V requirements in a more efficient way. Congress expressly provided for general permits for Title V and many states have experience issuing them. They appear to be a good fit for the numerous similar small sources we are primarily concerned about. Nonetheless, we still expect that the sheer volume of sources and number of different types of sources affected will present challenges. Further, any Title V general permit must comply with all requirements applicable to permits under Title V, and no source covered by a general permit may be relieved from the obligation to file a permit application under section 503 of the Act. We seek comment on whether source characteristics and applicable requirements are similar enough for a general permit approach to be helpful, for what categories it would provide the greatest benefit, and the degree to which it would or would not ease the expected difficulties with implementing a GHG Title V program.

d. Fees

Title V contains a self-funding mechanism requiring that permitting authorities collect permit fees adequate to support the costs of running a Title V program. Title V fees must be used solely to run the permit program. For GHGs, the possibility of a huge influx of new sources raises questions about how permitting authorities should adjust their fee schedules to ensure that they have adequate resources to permit these sources. Title V provides significant flexibility to permitting authorities in setting their fee schedules so long as they can demonstrate that fees are adequate to cover all reasonable costs required to develop and administer the Title V program requirements.[288] The additional resource burden imposed by GHG sources will depend heavily on what approaches EPA and states ultimately adopt for tailoring the program for these sources, but EPA does expect that some additional resources will be necessary under virtually any scenario.

Most states charge Title V fees on a dollar/ton basis, and actual amounts vary from state to state. For 2008, EPA charges $43.40 per ton, but only for regulated pollutants for the fee calculation (which generally includes all regulated pollutants but excludes carbon monoxide and some other pollutants). Because of the large mass emissions of GHGs and especially of CO_2 compared to other pollutants, if EPA and states charge fees for GHG emissions based on cost/ton numbers for criteria pollutants or HAPs, we expect that the fee revenues would be grossly excessive for what is needed to process permits for GHG sources. This is particularly true for the universe of small sources brought into Title V solely for their GHG emissions because those permits are expected to be relatively simple and may be addressed through general permits. Therefore we believe that it is appropriate for permitting authorities to consider other available options for covering their GHG source permitting costs, including: substantially lower cost per ton fees for GHGs, fixed fees (e.g., one time or annual processing fee that is the same for all applicants below a certain size), and/or charging no

[288] See CAA section 502(b)(3), which also lists specific activities whose costs must be covered.

fees for smaller GHG sources. We ask for comment on these and other suggestions for permitting authorities to use on structuring their fee provisions. We also request comment on the expected resource burden resulting from new GHG permitting, and how EPA should determine the adequacy of fees. EPA rules contain an optional method for permitting authorities to use in calculating a presumptively adequate fee. These regulations do not include GHGs as a regulated pollutant for this calculation, but could in the future if GHGs were regulated under certain parts of the Act. For permitting authorities that still use this presumptive calculation, we ask for comment on whether, for the reasons described above, EPA should specifically exclude GHGs from this calculation or address it in a different manner. Finally, because EPA itself is the permitting authority for some sources, we are also interested in comments on whether and how EPA should change its fee structure in its part 71 permitting regulations to meet its own increased resource needs from GHG permitting.[289]

e. Coordinating Timing with Other Actions

Like PSD, the timing of any approach to streamline Title V must be coordinated with other GHG actions under the CAA. We believe that any EPA determination about the applicability of the Title V program to GHGs should be accompanied by an explanation of how EPA plans to address – and how we recommend that State and local permitting authorities address -- the numerous implementation challenges such a determination would pose. This timing is perhaps even more important for Title V than

[289] Technically these increased resources would need to be provided to EPA through increased appropriation, as the EPA fee revenues would go to the general treasury.

for PSD because of the potential for an extremely large number of new sources and the fact that Title V applications would (unless a phase in approach is adopted) all be due at the same time, whereas PSD applications would come in over time as sources construct or modify. We seek comment on timing issues in general, and particularly on the coordination of the timing of Title V applicability with the timing of GHG regulation under other parts of the Act.

We specifically request comment on the timing of the applicability of Title V permit requirements in relation to the applicability of GHG control requirements. Consider the scenario where EPA issues a rule regulating GHGs from mobile sources, and then issues a series of rules regulating GHGs from categories of stationary sources. One possible interpretation of the Act and EPA's regulations is that the mobile source rule would trigger the applicability of Title V, at which point the hundreds of thousands of 100-ton and above sources would become subject toTtitle V and would have one year to apply for Title V permits. Generally, however, these permits would initially contain no applicable requirements for control of GHGs (mobile source requirements are not included in Title V permits), and would likely contain no applicable requirements for other pollutants, or only some generally applicable SIP rules that apply to sources which had previously not needed Title V permits. We have discussed the challenges of issuing even these minimal permits in such large numbers. However, as EPA proceeded to issue stationary source rules, each permit with three or more years remaining on its term would, under current rules, have to be reopened within 18 months of promulgation of each new rule to incorporate any applicable requirements from the new rule that would apply to the permitee. For permits with less than 3 years remaining, the applicable requirements would be incorporated at permit renewal. This scenario would result in duplicative effort as permitting authorities issued hundreds of thousands of minimal Title V permits with no GHG requirements, followed by a period of numerous reopenings for some GHG source categories, while the requirements for other GHG source categories would remain off-permit until renewal, at which point they would need to be included in the renewal permit. We ask for comment on how best to tailor the options above to minimize duplicative effort and maximize administrative efficiency in light of these timing concerns, and on whether additional options may be needed.

G. Alternative Designs for Market-Oriented Regulatory Mechanisms for Stationary Sources

EPA believes that market-oriented regulatory approaches merit consideration under section 111 or other CAA authorities for regulating stationary source emissions, along with other forms of regulation. Economic efficiency advantages of market-oriented approaches that have the effect of establishing a price for emissions were discussed in section III. This section discusses four types of market-oriented approaches:

- A cap-and-trade program, which caps total emissions from covered sources, providing certainty regarding their future emission levels, but not their costs.
- A rate-based emission credit program (also called a tradable performance standard), which imposes an average mass-based emission rate across covered sources but does not cap total emissions, so emissions could rise with increased production.

- An emissions fee, which sets a price for emissions but doesn't limit total emissions from covered sources.
- A hybrid approach, which could combine some attributes of a rate-based emissions trading system and some attributes of a tax. A variety of hybrid approaches are possible; the best-known is the combination of a cap-and-trade system with a "price ceiling." With a price ceiling, if the price of allowances exceeds a certain level, the government makes allowances available to the market at the ceiling price.

For a local pollutant, a regulatory approach that provides certainty concerning future emissions can provide a predictable level of protection, within modeling uncertainties. In the GHG context, certainty concerning the amount of emission reduction to be achieved by a U.S. program can make possible an estimated change in predicted warming, but does not provide certainty that the U.S. will achieve a desired level of climate protection. This is because GHGs are global pollutants and the level of climate protection provided depends on the actions of other countries as well as the U.S.

There is a robust debate about the respective merits of policies that provide price certainty, but not emissions certainty, and policies that provide emissions certainty, but not price certainty. A variety of cost-containment mechanisms have been proposed for GHG cap-and-trade systems; these mechanisms offer different tradeoffs between emissions certainty and price certainty.

EPA requests comment on the extent to which CAA legal authorities would accommodate each of these regulatory approaches. In the section 111 context, we note that these market-oriented approaches could be used in lieu of, or in addition to, other options including emission rate standards, technology-based standards, or work practices. With respect to section 111, EPA recognizes that these market-oriented approaches may differ in significant ways from the manner in which we have historically designed emission standards and required compliance with those standards. For this reason, we request comment on the extent to which each of these approaches could meet the statutory definition of a "standard of performance" and on what additional criteria or conditions could be considered to ensure that they do so. We also seek comment on how these options compare based on the policy design considerations listed in section III.F.1, including effectiveness of risk reduction, certainty and transparency of results, economic efficiency, incentives for technology development, and enforceability.

1. Emissions Cap-and-Trade

A cap-and-trade system limits GHG emissions by placing a cap on aggregate emissions from covered sources. Authorizations to emit, known as emissions allowances, are distributed to companies or other entities consistent with the level of the cap. Each allowance gives the holder an authorization to emit a fixed amount of emissions (e.g., one ton) during a given compliance period. At the close of the compliance period, sources must surrender allowances equal to their emissions during that period. Such a system does not impose limits on emissions from individual sources; rather, it caps emissions across a group of sources (e.g., an industry sector) and allows entities to buy and sell those allowances with few restrictions. Key features of a well-designed cap-and-trade program include accurate tracking and reporting of all emissions, compliance flexibility, and certainty (provided by the cap) in achieving emission reductions. While the cap provides certainty in future emissions, cap-and-trade does not provide certainty of the price, which is determined by the market (price uncertainty diminishes as certainty regarding control costs increases).

EPA has previously authorized emissions trading under section 111. For instance, EPA promulgated standards of performance for new and existing electric utility steam generating units on May 18, 2005 (70 FR 28606), establishing a mercury emissions cap-and-trade program for coal-fired electric generating units that states could use to meet their section 111 obligations to control mercury for coal-fired electric generating units. While the court subsequently vacated this action, the ruling did not address the legality of trading under section 111.

If EPA designed a cap and trade program that could cover certain source categories covered by section 111, such a program could be modeled after similar trading programs theAgency has developed under sections 110 and 111 of the Act, such as the NOx Budget Trading Program, the Clean Air Interstate Rule NOx and SO_2 trading Programs, and the Clean Air Mercury Rule Trading Program. Under this model, EPA would establish appropriate state GHG emissions budgets covering emissions of GHG for each covered source category. EPA would establish consistent rules related to subjects such as monitoring, applicability and timing of allocations that states would be required to meet. EPA would develop and administer a GHG allowance tracking system, similar to tracking systems the Agency administers for SO_2, and NO_X. EPA would determine provisions for monitoring, reporting, and enforcement. If states promulgated rules consistent with the requirements set forth by EPA, sources in their State could participate in the trading program. Alternatively, states could develop alternative regulatory mechanisms to meet the emissions budgets.

A key component of an emissions cap-and-trade program is the ability to accurately monitor emissions.[290] For many, but possibly not all, large stationary sources, there are methods to monitor CO_2 that may provide enough accuracy for a cap and trade program. Most large utility boilers are already required to monitor and report CO_2 emissions under the Acid Rain Program. Utility and industrial boilers are well suited to cap-and-trade; many participate in SO_2 and NO_X trading under the Acid Rain and NOx SIP Call programs. At refineries, some emission sources could be well suited to cap-and-trade, while for others, accurate monitoring methods or other ways to track and verify emissions may not be available. More analysis is needed to determine availability of monitoring methods for all refinery emission sources. The cement industry is another that may be well suited to emissions cap-and-trade, since monitoring is available and a number of facilities currently participate in NO_X trading under the NO_X SIP Call. Cap-and-trade may not be an appropriate mechanism for the landfills, except for potential use of landfill gas projects for offsets. The quantity of landfill methane captured and combusted (i.e. the emission reduction) can be measured directly; however, total emissions are difficult to measure.

We request comments generally on the use of cap-and-trade programs for GHGs under section 111 and other CAA authorities, including design elements such as opportunities for sources to opt into such programs, inter-sector trading and offsets, allowance auctions, cost containment mechanisms, and conditions or safeguards to ensure

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[290] While monitoring is important for determining compliance in all regulatory emission reduction approaches, in a cap-and-trade system monitoring is also important for functioning of the allowance market.

that emission reduction goals are met and that local air quality is protected. Particular issues to consider include whether it be allowable under section 111 to develop a cap and trade program that covered multiple source categories or would each source category have to be covered under a source-category-specific cap-and-trade program. Another issue is whether it would be legally permissible to allow offsets (i.e.,obtaining emission reductions from sources outside of the capped sector) to meet the requirements of section 111.

2. Rate-Based Emissions Credit Program

A rate-based emissions credit program – also called a tradable credit standard or intensity target program – is an emissions trading mechanism. Unlike cap-and-trade, however, a rate-based credit program does not impose a cap on aggregate emissions from covered sources. Rather, a rate-based emissions credit program establishes a regulatory standard based on emissions intensity (e.g., emissions per unit of input, emissions per unit of product produced, emissions per revenue/value-added generated). To the extent that a covered source has an emission rate below the regulatory intensity standard, the source generates credits that it can sell to sources with emission rates higher than the regulatory intensity standard. The price of credits would be determined by the market.[291] The regulatory intensity standard might be set below the recent average intensity for a

[291] Credits are generated by a source with emissions below the regulatory intensity (or rate). Credits are measured in a fixed unit of emissions, e.g., a ton. A source that emits at an intensity higher than the regulatory intensity must surrender credits—purchased from a source with emissions below the regulatory intensity or other entity holding credits—equivalent to the difference between their actual emissions and the allowable emissions.

given industry.[292] Once in place, the standard would determine the average emissions intensity (or rate) of the regulated industry.

Like a cap-and-trade approach, a rate-based trading approach can reduce the cost of reducing emissions from a group of sources, relative to the cost of requiring every source to reach the same emission rate. A drawback of the rate-based approach is that it provides an incentive to increase whatever is used in the denominator of the rate (e.g., the output of a good or the amount of a particular input). Therefore, rate-based policies can encourage increased production because production can be rewarded with additional credits. This in turn has the potential to encourage increased emissions and thus to raise the overall cost of achieving a given level of emissions.

Many of the considerations described above for cap-and-trade program design would also apply to design of a rate-based credit program. Measuring outputs to determine the regulatory intensity may present some difficulty. In particular, determining the intensity for facilities that generate multiple products would be challenging. Sectors that use multiple inputs (e.g., different fuels) might require use of a common metric (e.g., Btu combusted) to support a rate-based approach based on inputs.

Rate-based trading programs are most easily applied in a specific sector where facilities have similar emissions characteristics. For utility and industrial boilers, a rate-based credit standard could be established for GHG emissions. For refineries, rate-based credit standards could be established for individual processes or equipment but would be

[292] The average intensity could be set using any of a number of metrics and baselines. For example, the metric might be tons of CO2 emitted per ton of cement produced. The baseline year for calculating average intensity might be the same as the compliance year, i.e. after the close of the compliance year the average tons CO2 emitted per ton of cement produced would be calculated across the industry and a source that produced with emissions above the average would need to buy credits while a source that produced with emissions below the average could sell credits. Alternatively, the average intensity could be based on a year prior to the initial compliance year.

difficult to set at the facility level. A GHG emissions rate-based tradable credit standard could be developed for the Portland cement industry. This mechanism may not be appropriate for landfills (see discussion of monitoring above).

We request comments on the use of emission rate trading programs under section 111 or other CAA authorities. Similar to cap-and-trade programs, we are seeking comment on whether sector-specific programs or inter-sector programs might be more appropriate. We also request comment on issues related to defining emission rates for facilities producing multiple types of products.

3. Emissions Fee

A GHG fee would limit GHG emissions by placing a price on those emissions. The price is fixed up front (unlike cap-and-trade where the price depends on the market), and a source covered by the tax would pay to the government the fixed price for every ton of GHG that it emits. A GHG fee permits the aggregate amount of emissions to adjust in response to the tax, in contrast to a cap-and-trade system where the quantity of emissions is fixed. Some key features of a GHG fee include accurate tracking and reporting of all emissions from covered sources, compliance flexibility, and certainty in the price of emissions (but not certainty in future emissions because there is no cap). As noted in the cap-and-trade subsection above, the emissions of CO_2 from most large utility boilers are already accurately monitored; this attribute would facilitate application of an emissions tax (as well as facilitating application of a cap-and-trade system).

Depending on the specific authority granted by Congress with respect to the disposition of revenue, the revenue generated by the fee (as with potential auction revenues under a cap-and-trade approach) could theoretically be used for any number of public purposes. Note that depending on how the money was spent, the use of the revenues would have the potential either to reduce or to increase market distortions that reduce economic welfare.

The issue of whether the CAA authorizes emissions fees is discussed above in section III.F.2.

4. Hybrid Market Based Approach

A hybrid, market-oriented approach that could be used to regulate GHG borrows from pollution control options that are based on setting emissions rates, emissions credit trading, and emissions fees. This approach starts with a rate-based emissions credit program in which an average emission rate (e.g., tons of GHGs emitted per unit of output or input) would be established for a given industry. As with a typical rate-based policy, a source in the given industry would need to buy credits to the extent it produces with emissions over the average intensity, and could sell credits to the extent it produces with emissions below the average. An element of an emissions fee approach would then be added to this policy in which the government would also buy and sell credits. The government could set a price for credits based on selected policy criteria, and offer credits to sources at that predetermined price. Sources could then buy credits from the government as well as other regulated sources. Therefore, the government-set price would act as a price ceiling (or "safety-valve"), and the potential for price fluctuations in emissions credits would be diminished (because the government's predetermined price would act as a ceiling price). As long as relatively cost-effective GHG emissions reductions could occur within a covered sector over time, the average emissions intensity may decline and total reductions in emissions would occur in a relatively cost-effective manner without significant government handling of emissions fee revenues. In addition to being a seller, the government could also act as a buyer (so the government sales of credits would not result in an excess supply). A similar approach without the government's role in selling credits at a ceiling price and with a fixed schedule of allowable average annual rate of allowable emissions was actually successfully used in the phase down of lead in gasoline in the 1980s by EPA.

Some have suggested that the government could set a price for GHG credits or allowances based on its assessment of those benefits to be gained from the GHG emissions reduction per unit of output or input. In theory, under this approach the marginal compliance costs would never exceed the marginal benefits of reducing emissions. Note, however, that there are serious issues to be resolved regarding whether and how a defensible single estimate of marginal GHG reduction benefits can be developed for this purpose (see section III.G). First, whether the scope of benefits counted is global or domestic could significantly affect the marginal benefits estimate. Second, for benefits categories that can be quantified and monetized, there are many uncertainties that result in a range of legitimate estimates, making it difficult to pinpoint an appropriate number. Third, there is a bias toward underestimating benefits of GHG reductions because many impacts categories identified by the IPCC are not quantified and monetized.[293] As a result, the price might be set too low to achieve the amount of emissions reductions that would be warranted considering all benefits and policy goals.

By including this discussion, EPA is not taking a position on whether it has legal authority to pursue a hybrid market-oriented approach. (See section III.F.2 above.) However, the agency seeks comment on the general matter of how the pricing of credits within an emissions intensity approach might be designed and established, what legal authority would be necessary for this action, and what impact different price-setting approaches would have on aggregate emissions reductions, costs and benefits.

VIII. Stratospheric Ozone Protection Authorities, Background, and Potential Regulation

A. Ozone Depleting Substances and Title VI of the Clean Air Act

Title VI of the CAA provides authority to protect stratospheric ozone, a layer high in the atmosphere that protects the Earth from harmful UVB radiation. Added to the CAA in 1990, Title VI establishes a number of regulatory programs to phase out and otherwise control substances that deplete stratospheric ozone. These ozone-depleting substances (ODS) are used in many consumer and industrial applications, such as refrigeration, building and vehicle air conditioning, solvent cleaning, civil aviation, foam

[293] There also are policy considerations that would be neglected by an approach attempting to find a point at which marginal costs equal marginal benefits. Examples include irreversibility of changes in climate with adverse impacts affecting future generations who cannot take part in today's decision-making, and unequal geographic distribution of adverse climate change impacts.

blowing, and fire extinguishing, and even in small but important uses such as metered dose inhalers.

Many ODS and some of the substances developed to replace them (e.g., HFCs) are also potent GHGs. As described below, Title VI programs have already achieved significant reductions in emissions of ODS and thus in emissions of GHGs. However, the ODS being phased out are not among the six major GHGs addressed by this notice. Because these ODS are already being addressed by international and national requirements for protecting stratospheric ozone, they are not covered by UNFCCC requirements, the President's May 2007 directive or many other efforts to address climate change. Similarly, the discussion in this notice of a potential endangerment finding for GHGs does not include in its analysis the ODS being phased out.

In this section of the notice, we briefly describe Title VI regulatory programs as they relate to ODS because of the GHG emission reductions they achieve. We also consider the Title VI program for regulating ODS substitutes, since some substitutes are also GHGs. Since our focus in this notice is on potential use of the CAA to control the six major GHGs, we also examine the general authority in section 615 as it might be used to control those GHGs. However, as further explained below, section 615 would be available for that purpose only to the extent that EPA finds that emissions of the major GHGs are known or reasonably anticipated to cause or contribute to harmful effects on stratospheric ozone or otherwise affect the stratosphere in a way that may reasonably be anticipated to endanger public health or welfare. Unlike other CAA provisions examined in this notice, section 615 would not be triggered by a finding that one or more GHGs cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. The potential applicability of section 615 to the major GHGs depends on whether specified findings related to the stratosphere or ozone in the stratosphere could be made. In this way, Title VI is significantly different from other CAA titles that provide more general regulatory authority to address air pollutants that meet an endangerment test.

1. Title VI Regulatory Programs

Existing Title VI programs are largely focused on reducing and otherwise controlling ODS to protect stratospheric ozone. The cornerstone Title VI program is a graduated phaseout of ODS that implements similar requirements in the Montreal Protocol on Substances that Deplete the Ozone Layer, an international treaty to which the U.S. is a party. The Title VI phaseout program relies on a system of marketable allowances to control overall U.S. consumption (defined as production + imports – exports) consistent with the Protocol's requirements. EPA tracks production, export, and import of ODS, as well as transactions in ODS allowances reflecting the flexibility inherent in the program's market-oriented approach. This ensures compliance with U.S. consumption caps established under the Protocol. The program also allows exemptions from the phaseout to ensure that supplies of ODS critical to certain sectors, like the agricultural fumigant methyl bromide, are available until alternatives adequately penetrate the marketplace.

Other Title VI provisions supplement the phaseout program in a variety of ways that enhance ozone layer protection. Under these provisions, EPA has established a national ODS recycling and emission reduction program, bans on nonessential ODS uses, a program for labeling ODS-containing products, and the Significant New Alternatives Policy (SNAP). Under the SNAP program, EPA reviews and approves substitutes for ODS to help spur the development and uptake of safer alternatives. Finally, Title VI authorizes EPA to accelerate the schedule for phasing out ODS as warranted by scientific information, the availability of substitutes, or the evolution of the treaty's requirements pursuant to international negotiations among Parties to the Montreal Protocol.

Title VI has achieved large reductions in ODS consumption and emissions, and consequently has reduced GHG emissions and slowed climate change. According to a recent study, by 2010 ozone layer protection will have done more to mitigate climate change than the initial reduction target under the Kyoto Protocol, amounting to avoided emissions of 11 billion metric tons of CO_2 equivalent per year, or a delay in climate impacts by about 10 years.[294]

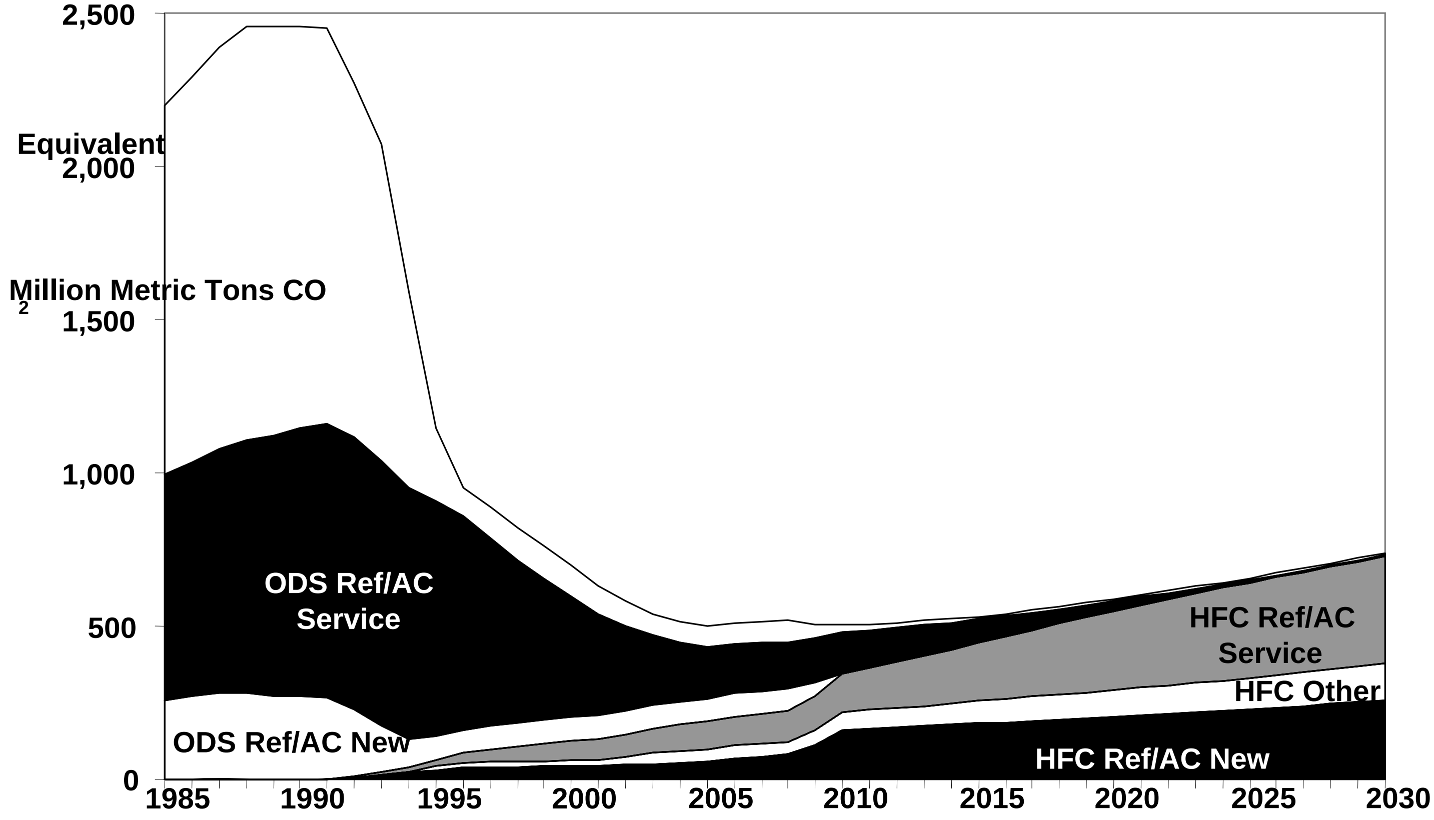
Because some ODS substitutes are GHGs, some have asked whether the net effect of the Protocol on climate has been beneficial. Recent research has demonstrated that the climate impact of ODS (e.g., chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs)), compared to CO_2 emissions from fossil fuel combustion, fell from about 33 percent in 1990 to about 10 percent in 2000. The following graph shows how the shift over time toward ODS alternatives under Title VI has created a marked downward trend for GHG consumption in sectors that use ODS and their substitutes, even while these uses have grown with the U.S. economy and population. As can be seen below, consumption of the ODS (CFCs, HCFCs, etc.) in 2004, although significantly lower than

[294] Velders, G.J, et. al., *The Importance of the Montreal Protocol in Protecting Climate,* Proceedings of the National Academy of Sciences, March 2007.

peak ODS emissions in 1990, were actually greater than consumption of HFCs, which are substitutes for CFCs and HCFCs.

In view of the GHG emission reduction benefits of existing Title VI programs, EPA seeks public comment on how elements of the existing Title VI program could be used to provide further climate protection while assuring a successful completion of the ODS phaseout, including a smooth transition to alternatives.

Figure VIII-1



2. Further Action under the Montreal Protocol

The Montreal Protocol has been and will continue to be an important, if limited, step in addressing climate change. At the 19th Meeting of the Parties in September 2007, the Parties agreed to more aggressively phase out a class of ODS, the hydrochlorofluorocarbons (HCFCs). The agreement to adjust the phase-out schedule for HCFCs is expected to reduce emissions of HCFCs to the atmosphere by 47 percent, compared to the prior commitments under the treaty over the 30-year period of 2010 to 2040. For the developing countries, the agreement means there will be about a 58 percent reduction in HCFC emissions over the same period.

The climate benefits of the faster phase-out of HCFCs will depend to some extent on technology choices in the transition from HCFCs. The estimated climate benefit of the new, stronger HCFC phase-out may be approximately 9,000 million metric tons of CO2e. A byproduct of the manufacture of HCFC-22 is hydrofluorocarbon -23 (HFC-23), a gas that does not damage ozone in the stratosphere but has a very high GWP. Because this gas is produced in higher quantities in lower efficiency production, to the extent that HCFC-22 production in the developing world remains uncontrolled, additional HFC-23 would be created. Thus, the agreement to sharply limit future developing world production of ODS represents an important opportunity for climate protection, as well as ozone layer recovery, as the President recognized in his April 16, 2008 speech on climate change.

B. Title VI Authorities Potentially Applicable to the Major GHGs

As mentioned previously, the framework created by Title VI could be effective in achieving GHG reductions by reducing and controlling ODS and ODS substitutes through existing mechanisms for tracking production, evaluating new safer alternatives, and addressing the needs of the major contributing subsector, refrigeration and air conditioning, through technician training, emission reduction and recycling. In this section we review Title VI provisions that could potentially apply to efforts to reduce the major GHGs that are not also ODS or ODS substitutes.

Title VI mostly includes provisions specific to individual ODS and programs. The provisions generally apply to "class I" or "class II" ODS. Title VI requires EPA to list specified substances as class I and class II ODS, and authorizes EPA to add other substances to either category if the Agency makes certain findings regarding the substance's effect on stratospheric ozone (see sections 602(a) and (b)). One important difference between class I and class II ODS is that class I substances include the most potent ODS; section 602(a) requires EPA to list as class I substances all substances with an ozone depletion potential of more than 0.2.[295]

Title VI also requires EPA to publish the global warming potential (GWP) of each listed ODS. Section 602(e) further provides that the requirement to publish GWP for a listed substance "shall not be construed to be the basis of any additional regulation under" the CAA.

Since the major GHGs being addressed in this notice have no ozone depletion potential, it appears that the Title VI provisions that authorize regulation of listed ODS are of limited potential use for regulating those GHGs. EPA requests comment on the

[295] The ozone depletion potential (ODP) of a chemical measures its ability to reduce stratospheric ozone compared to a common ODS known as CFC-11. While this and another common ODS have ODPs of 1.0, the ODPs of class I and class II ODSs known to be in use range from 0.02 to 10.

potential applicability of ODS-specific Title VI authorities, and the significance of the section 602(e) language quoted above for regulation of GHGs under Title VI.

1. Section 615

In addition to the specific provisions that authorize regulation of listed ODS and in some cases ODS substitutes, Title VI also includes general authority in section 615 to protect the stratosphere, especially stratospheric ozone. Section 615 states:

> *If, in the Administrator's judgment, any substance, practice, process, or activity may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, and such effect may reasonably be anticipated to endanger public health or welfare, the Administrator shall promptly promulgate regulations respecting the control of such substance, practice, process or activity, and shall submit notice of the proposal and promulgation of such regulation to the Congress.*

While Title VI was added to the CAA in 1990, a provision largely identical to section 615 was added to the Act in 1977, soon after concerns about the effects of some substances on the stratosphere were initially raised. In 1988, EPA promulgated regulations implementing the first round of requirements of the Montreal Protocol through a system of tradable allowances under section 157(b) of the CAA as amended in 1977. Section 157(b) was subsequently modified by the 1990 Amendments and became section 615.

Since 1990, EPA has rarely relied on the authority in section 615 to support rulemaking activity, since the activities that the Agency regulates to protect stratospheric ozone have generally been addressed under the more specific Title VI authorities. However, in 1993 EPA did rely on section 615 to promulgate trade restrictions in order to conform EPA regulations to Montreal Protocol provisions on trade with countries that were not Parties to the Protocol. (March 18, 1993, 58 FR 15014, 15039 and December 10, 1993, 58 FR 65018, 65044). These trade restrictions prevented shipments of ODS from the U.S. to countries with no regulatory infrastructure to control their use. Promulgating these restrictions reduced the release of ODS into the atmosphere, thereby reducing harmful effects on public health and welfare. The restrictions also resulted in eliminating the U.S. as a potential market for ODS produced in non-Parties, thereby discouraging shifts of production to non-Parties and limiting the potential for undermining the phaseout.

Section 615 authority remains available when other CAA authorities are not sufficient to address effects on the stratosphere, especially ozone in the stratosphere. For example, in the late 1990s, EPA, the National Aeronautics and Space Administration (NASA), and the Federal Aviation Administration (FAA) considered options for addressing potential ozone depletion resulting from supersonic commercial aircraft. EPA and NASA analyzed the impacts from a theoretical fleet of supersonic commercial aircraft, known as High Speed Civil Transport (HSCT), and in an October 1998 Memorandum of Agreement between the two agencies (signed by Spence M. Armstrong, Associate Administrator for Aeronautics and Space Transportation Technology (NASA) and Robert Perciasepe, Assistant Administrator for Air and Radiation (EPA)) noted the potential to rely on section 615 in conjunction with other regulatory authorities.[296]

While section 615 sets forth the authority and responsibility of the Administrator to address effects on the stratosphere in order to protect public health and welfare, EPA recognizes that this authority was intended to augment other authorities and responsibilities established by Title VI. EPA does not believe this authority is a basis for prohibiting practices, processes, or activities that Congress specifically exempted elsewhere. For example, EPA does not intend to promulgate regulations eliminating the exceptions from the ODS phaseout for essential uses as established by section 604.

For section 615 authority to be used, a two-part endangerment test unique to that section must be met. First, the Administrator must find, in his judgment, that "a substance, practice, process or activity may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere." Second, he must determine that "such effect may reasonably be anticipated to endanger health or welfare." To determine the potential applicability of section 615 to major GHGs, EPA thus would have to consider whether available scientific information supports making the requisite findings.

The effect on the stratosphere of GHG emissions and of climate change generally is a topic of ongoing scientific study.[297] Recent science suggests that feedback mechanisms exist that allow temperatures in the stratosphere and troposphere to be mutually reinforcing or mutually antagonistic depending on a number of factors, including the latitude at which the ozone loss occurs. Further research is underway to better understand these interactions. While it is beyond the scope of this notice to assess

[297] See, e.g., World Meteorological Organization, Global Ozone Research and Monitoring Project – Report No. 50, *Scientific Assessment of Ozone Depletion: 2006*, Ch. 5, Climate-Ozone Connections.

and analyze the available scientific information on the effect of GHGs on the stratosphere, EPA requests comment on how evolving science might be relevant to the Agency's potential use of section 615. More specifically, EPA requests comment on how scientific research might help resolve areas of ambiguity in the relationship between GHGs, effects on the stratosphere, and climate change, and how this might help the Administrator make appropriate judgments in applying the two-part test of section 615.

If the requisite endangerment finding is made, the regulatory authority provided by section 615 is broad. While most Title VI authorities are applicable to class I or class II substances or their substitutes, section 615 authorizes regulation of "any substance, practice, process, or activity" which EPA finds meets the two-part endangerment test. As noted elsewhere in this notice, depending on the nature of any finding made, section 615 authority may be broad enough to establish a cap-and-trade program for the substance, practice, process or activity covered by the finding, if appropriate. Title VI provisions provide other examples of possible regulatory approaches, such as maximizing recapture and recycling and requiring product labeling. EPA requests comment on possible regulatory approaches under section 615 and how those approaches would be affected by the particular endangerment finding that is a prerequisite to the use of section 615 authority.

2. Section 612

Section 612 is also relevant to today's notice to the extent a GHG may be used as a substitute for an ODS. CAA section 612 provides for the review of alternatives to ODS and the approval of substitutes that do not present a risk more significant than other alternatives that are available. Under that authority, the SNAP program has worked collaboratively for many years with industries, user groups, and other stakeholders to create a menu of alternatives that can be substituted for the ODS as they are phased out of production in the U.S.

In recent years, industry partners in the motor vehicle air conditioning (MVAC) sector have urged EPA to identify and approve appropriate new substitutes to allow for the implementation of a world-wide platform that will satisfy the needs of the U.S. market while also meeting new requirements in the European Union, which call for a transition over approximately six years beginning with the 2011 model year into non-ODS alternatives with Global Warming Potentials (GWPs) of less than 150.

To address these concerns, EPA proposed in September 2006 a SNAP rulemaking that provided for the use of CO_2 and HFC-152a in MVACs (71 FR 55140 --- docket no. EPA-HQ-OAR-2004-0488). In a separate action (INSERT FR CITE), EPA has made final the portion of the rulemaking related to HFC-152a. This substitute meets the EU requirements, while also providing a new avenue for automakers to replace ODS. We believe we should issue guidance on the use of CO_2 as an MVAC alternative in the context of the broader considerations of regulating GHGs set forth in this notice. We have included in the docket cited above a summary of our proposal regarding CO_2 as an alternative from MVACs. This summary reflects our latest thinking on the safe use of CO_2 in those systems.

List of Subjects in 40 CFR Chapter I

Environmental protection, Air pollution control.

Dated:

Stephen L. Johnson,

Administrator