# STATEMENT TO THE SELECT COMMITTEE ON ENERGY INDEPENDENCE AND GLOBAL WARMING

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By

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Mr. Chairman, Mr. Sensenbrenner, other members of the Committee, thank you for the opportunity to appear before you today. I am Lee Lane, a Resident Fellow at the American Enterprise Institute. AEI is a non-partisan, non-profit organization conducting research and education on public policy issues. AEI does not adopt organizational positions on the issues that it studies, and the views that I express here are mine, not those of AEI.

Rising amounts of greenhouse gases (GHGs) in the atmosphere pose worrisome challenges. While many uncertainties persist, I believe that the potential risks from climate change could be large. At the same time, a thicket of intractable problems blocks quick or easy solutions. Progress on climate policy will require us to wrestle with these problems over many, many decades. My statement suggests some ways in which the US might make progress on this task. It makes three main points.

First, we need to acknowledge that a seeming global consensus on the need to halt the rise in GHG levels masks a distinct lack of consensus on willingness to pay the required costs. Thus, many nations, China, India, and Russia prominent among them, reject all demands that they shoulder this burden. That China is willing to announce some no-regrets climate policies is a good thing. It will be better still if it implements them – something that is far from certain.[1] But a grab bag of marginal policy innovations is not something that will alter the basic realities of the problem.

Second, the dismaying truth is that the US cannot create global consensus where none exists. Efforts to lead by the example of stringent GHG reductions will be self-defeating. They would, in effect, make winning future concessions from China and India even more difficult. Conversely, current proposals to use trade sanctions to bludgeon other nations into adopting controls are too weak to compel such costly action.[2] And such proposals pose significant risks to the global trade regime.

Despite Chinese and Indian demands, having developed countries simply pay the costs of developing country GHG controls is not a viable option. A recent MIT study estimated that carrying this principle to its logical conclusion would, for the US alone, entail *annual* income transfers of $200 billion by 2020 and of nearly $1 trillion by 2050.[3] This would heap a huge additional burden on a US economy that, during this same period, will already be struggling to make many other daunting structural adjustments.

Third, the US government's climate policy should explicitly recognize the substantial likelihood that the needed global consensus on GHG curbs will be long in coming. The world is very likely to miss today's ambitious targets for GHG stabilization. Rather than striving to do the impossible, US policy should place great stress on fostering relevant new technologies. One way of doing so would be place a modest, stable, and gradually rising price on GHG emissions. I include a statement from a recent conference at Stanford University that describes other essential steps toward achieving this goal.

The statement notes the need to expand R&D directed at adjusting to the climate change that is unavoidable. And it notes explicitly that part of that effort should be directed to

exploring so-called geoengineering technologies. Adaptation, by whatever means, needs more attention.

Finally, I would like to conclude with a note of caution. The US, like most other nations, has an important stake in curbing global GHG emissions. But if our good intentions lead us to incur costs that exceed the benefits *to America*, those policies may not prove to be durable. A zigzag course on climate policy is likely to serve neither this nation nor the world.

## The missing consensus on willingness to pay for GHG control

Given twenty years of failure to achieve meaningful progress on global GHG controls, one should ask, what structural changes are required to produce a different outcome, and have those changes, in fact, occurred?

### *A record of futility*

The year 2008 was the 20th anniversary of the first meeting of the International Panel on Climate Change (IPCC). The IPCC's goal is to solve the problem of warming. So far, it has failed. According to the US Energy Information Agency, global emissions of $CO_2$, the most important industrial greenhouse gas, currently exceed the 1988 level by over a third. The IPCC reports that through the last several decades the rise in atmospheric concentrations of $CO_2$ has sped up.

Many Europeans blame the United States for this failure. They are especially harsh in criticizing the Bush Administration's rejection of the Kyoto Protocol. Even among observers who regarded Kyoto as a bad deal for the United States, the brusque manner in which President Bush rejected the Protocol seems in retrospect to have been unwise.[4]

The fact remains, though, that for America, Kyoto's high abatement costs and imposition of large income transfers from the US to other countries would almost certainly have made the Protocol a net loss. A multi-model assessment found that, in 2010, Kyoto would have cost the US between 0.24 percent and 1.03 percent of GDP.[5] Yet Kyoto would have had virtually no impact on global climate.[6] So whatever cost Kyoto imposed would have brought almost no benefit. On balance, it is less surprising that the US ultimately rejected Kyoto than it is that a US president had signed it in the first place.

Moreover, even in Europe, emissions continue to climb.[7] Where greenhouse gas emissions have fallen, changes in economic structure may have played a bigger role than has climate policy. In light of the record, faith in Europe's oft-repeated promises of swift GHG reductions would seem to demand a certain degree of credulity.

This experience raises a question that is pertinent to this new phase of climate policy. Have the conditions that doomed Kyoto to failure actually changed?

## *The necessity of curbing GHG growth from China and India*

GHG control policies can only succeed if they are based on coordinated multi-national action. A metric tonne of $CO_2$ has the same effect on warming wherever it originates, and fifteen to twenty nations around the world are major sources of GHG discharges. Economic growth will steadily raise the number of major sources. It is only a slight exaggeration to say that each of these states possesses an effective veto over global GHG control efforts.

Certainly, both China and India have such veto power. It is physically impossible to halt the rise of GHG levels if Chinese and Indian GHG emission growth is not reined in. With unchecked GHG growth from China and India, holding atmospheric GHG levels below 550 ppm would require the industrialized countries to somehow begin to capture more $CO_2$ than they emitted – and they would have to do so within thirty-five years![8]

China and India have so far flatly refused to incur significant costs in the cause of GHG reduction. To the contrary, their efforts at GHG control have been confined to what are, in effect, "no-regrets" policies. Both countries reject all firm commitments to GHG reduction targets. Rather, they have both demanded that the developed world commit to paying them for any emission reductions that they might undertake.[9] To some degree, the Bali Action Plan has endorsed this principle.[10] Thus, the current stance of the Chinese and Indian governments would seem to pose a rather stark challenge to the credibility of the entire enterprise of global GHG curbs.

## *The limited net benefits of GHG controls*

Part of the difficulty of forging an international GHG control accord can be traced to the high costs of curbing GHG emissions. If GHG cuts are deep and rapid, their costs are likely to exceed their benefits.[11] Studies have repeatedly confirmed that judgment.[12] To yield the greatest possible net benefits, GHG cuts should, therefore, start modestly and increase gradually over time. However, controls structured in this way avoid only part of the expected climate change.

In this regard, GHG controls contrast sharply with the control of ozone-depleting chemicals. With the latter, optimal controls yielded quite large net benefits. The much smaller net gain available from GHG control restricts the range of options for deal making.[13]

## *The international politics of GHG controls*

No third party exists to enforce participation in GHG limitation agreements, to compel performance of agreed actions, or to set standards. International politics is a self-help world; there is no 911 to call.[14] One result is that, in dealing with global problems, nations often have an incentive to free ride on the efforts of others.

In the case of GHG controls, the fact that nations differ so much in the degree to which they have an economic interest in curtailing warming vastly complicates the quest for international cooperation. These differences give rise to two further problems.

First, because nations differ in their level of concern about warming, they also differ in their willingness to incur the costs of restraining GHG discharges. An oil exporting country with a cold climate such as Russia has a lot less to gain from effective GHG controls than would the Maldives or the Sub-Saharan nations. The latter countries are more vulnerable to climate change. While there are quite a few high-GHG emitting countries that are poor and middle income,[15] most poor countries are not major emitters.[16] The latter countries may be threatened by climate change, but, on their own, they can do virtually nothing about it.

Second, in practice, even high-GHG poor countries lack the economic resources either to pay for GHG abatement elsewhere or to compel richer countries to adopt controls. Also, many poorer nations prefer to protect themselves from warming through economic development rather than by seeking to restrict GHG discharges. For middle income countries like China and India, industrialization can boost the ability to adapt to climate change. Of course, it can relieve many more acute problems as well. For these countries, slowing growth in order to control GHG discharges may simply be a bad investment.[17]

## Limits on US influence on global GHG control arrangements

For as long as these considerations apply, neither the United States, nor any other country or power bloc, will be able to install an effective global GHG control regime. Many inventive GHG control boosters have propounded schemes for breaking this political impasse. Their efforts have failed. New ones are likely to meet the same fate until the causes of the impasse are removed, and removing those causes is likely to take time.

### *Unilateral action as a poor means of building international consensus*

Congress is considering bills which, if enacted, would subject the US economy to strict GHG controls. Strict US controls, their advocates claim, would cause other nations, China and India among them, to adopt similar measures. Neither the historical record nor a fair reading of these countries' economic self-interest supports these claims.

As to the record, the Chinese government now claims that it will take some steps that will have the effect of lowering GHG discharges. The measures by which it proposes to make these reductions are classic no-regrets policies. Based on its statements at Bali, it has also offered to make further GHG reductions, but it appears to be willing to do so only if other nations pay much of the cost and transfer to China a great deal of advanced technology. India, at Bali, demanded that developed countries pay it for mitigation (and adaptation) as a matter of right. India also wishes to deny developed countries the ability to attach conditions to this aid.[18] This record strongly indicates that China and India place much greater stress on avoiding the costs of GHG abatement (and on gaining access at below cost to foreign technology) than they do on achieving the benefits of lowering emissions.

Economic self-interest, moreover, provides China and India with strong motives for resisting GHG limits. For example, as suggested above, from the standpoint of these countries, rapid economic development may well be a better response to climate change than GHG controls would be. Then too, neither China nor India may feel that its government enjoys enough popular support to be able to afford the political costs of GHG controls. To drive domestic energy prices above world market levels would be a daring political gamble for governments that have often gone to great lengths to hold those prices *below* world levels.[19]

America's unilateral adoption of stringent GHG limits would do nothing to weaken China's or India's motives for resisting controls. To the contrary, it would strengthen those motives. If the US adopts controls, it has thrown away a bargaining chip that it might have used in a future negotiation. Worse, the more other countries adopt GHG limits, the greater the competitive gains that China and India will reap by keeping their economies unencumbered by such controls. Over time, energy-intensive industries will migrate to the nations that resist GHG limits. And the increased concentration of energy-intensive capital and jobs in these countries will bolster the political incentives for resisting controls.[20]

If avoiding abatement costs is, indeed, a strong motive for China and India, the US would have little reason to believe that it could enforce an agreement – even if it made one. The seemingly perpetual problems with WTO enforcement illustrate that point all too well. The 2008 report on China of the US Trade Representative, while noting areas of progress, offered the following observation:

> "… in some areas it appears that China has yet to fully implement important commitments, and in other areas significant questions have arisen regarding China's adherence to ongoing WTO obligations, including core WTO principles. Invariably, these problems can be traced to China's pursuit of industrial policies that rely on excessive, trade distorting government intervention intended to promote or protect China's domestic industries. This government intervention, still evident in many areas of China's economy, is a reflection of China's historic yet unfinished transition from a centrally planned economy to a free market economy governed by rule of law."[21]

Similarly, the US government struggles – without great success – to ensure the safety of imported Chinese toys and food. Yet China clearly regards both the WTO regime and the reputation of its goods for safety as vital to its economic future. If China's *dirigiste* tradition and its weak rule of law disrupt its compliance with these trade-related regimes, how well would it implement GHG limits that it had been adopted only grudgingly?

The answer is not hard to guess. Further, America's record in enforcing product safety on Chinese products does not build much confidence on that side of the issue either. Could

the US government determine, say, if a cap-and-trade scheme had been enforced on state-owned enterprises in Qinghai? Would we be able to tell if the cap had been offset with concealed subsidies? Meanwhile, India seems very concerned to make sure that the developed countries have no real ability to curtail GHG-related transfers for non-performance or for any other reason.[22]

## *Trade sanctions will not lead to Chinese or Indian GHG controls*

One response to the China-India problem has been to propose to allow the US government to clap limited trade sanctions on other countries that fail to cap their GHG discharges. Such sanctions, their proponents maintain, would protect America's most energy-intensive industries from import leakage. They also hope that sanctions would prod China and India to adopt their own controls.

As a means of coercing China, this strategy would face long odds. There are two reasons for doubting that the incentive would work. China provides a perfect example of the grounds for skepticism.

First, China, by adopting domestic GHG controls, would handicap the competitiveness of most of its tradable products. This step would discourage exports and encourage imports. China's only compensation for accepting this result would be to eliminate US trade sanctions on a part of its trade with the United States. Moreover, the trade that might benefit from this substitution is a very small part of the Chinese economy. Less than 1 percent of Chinese steel production is sold to America in a form that would make it liable to sanctions. For aluminum, the number is only 3 percent. It is 2 percent for paper and less than 1 percent for both basic chemicals and cement.[23]

Second, one country adopting trade sanctions, or a few countries doing so, will merely change the geographic pattern of trade flows. It will not have much impact on the total demand for Chinese energy-intensive goods. US sanctions on China would cause countries with low-carbon processes for producing steel, aluminum, or other energy-intensive intermediate goods to increase their exports to the US. These countries could increase their own imports from China to fill the gap left by their higher exports. The Chinese would be largely indifferent to the change in trade flows. This option does not pose a serious economic threat to China, and it would certainly not compel China to adopt GHG controls.[24]

While sanctions would have little effect on China, they might threaten other US interests. For example, the precedent that they would set could further weaken the already fragile global trade regime. The threat is especially real given the tendency of the American political process to expand and escalate the effects of legislation that creates opportunities for restricting imports. The history of anti-dumping laws illustrates the grounds for concern.[25]

It seems likely that the sanctions Congress has considered so far would be ineffectual in compelling other countries to adopt GHG controls. In principle, though, the US might

devise and, if need be, deploy, stronger trade penalties. The problem with that approach is patent. Trade sanctions designed to punish China will also hurt Americans. They will harm consumers, retailers, freight carriers, and manufacturers that use imported parts. The greater the pain imposed abroad, the greater the likely costs at home.[26]

## *Will the Annex II countries pay to reduce China's GHG discharges?*

Alternatively, the US could offer to pay for China's GHG reductions as well as its own. Without question, this strategy is the one preferred by China, India, and the G-77 countries – for obvious reasons. At Bali, China and the G-77 countries demanded that the developed nations pay half of a percent to one percent of GDP to cover the costs of curbing GHG emissions in the developing world. Their demands at the Conference also extended to the transfer of technology at concessionary prices. India's demands, based on the position that it adopted at the Bali Conference, seem, if anything, more open-ended.

From a US standpoint, however, this approach has little to recommend it. A free ride of this kind creates incentives that will retard the process of China and India accepting the need to shoulder a significant share of the costs of controlling their own GHG discharges. Indeed, the more willing the US appears to be to entertain proposals that it will pay to abate other nations' GHG discharges, the more it will change the motives of the would-be recipients of its generosity. Once the principle is strongly established, every poor country with a substantial GHG output will have a strong motive to display a studied indifference to GHG controls. (I fear that this is, in fact, precisely what is happening.)

A less yielding bargaining stance on the part of the developed world would, over time, discover a growing Chinese and Indian self-interest in GHG controls. India, after all, is among the most vulnerable countries in the world to climate change. China, too, may have much to gain from slowing the pace of warming.[27] To be sure, the likely effects of future change remain unpredictable, and judgments vary as to each nation's relative share of the risks. Still, the stronger the evidence becomes suggesting future harm, the stronger the motives of today's most resistant nations to undertake control measures.

Without stiffer bargaining by developed nations, it is difficult to see how a viable global control regime can emerge. Placing on the developed world the full costs of making deep GHG cuts is an implausible option – as the MIT study strongly hints.[28] That study examined the costs of reducing GHG emissions by 50 percent by 2050. It found that the policy of giving the developing countries a full free ride on abatement costs would, for the developed world, entail a loss in economic welfare of 2 percent in 2020 and 10 percent by 2050. US losses could be greater or smaller, depending on how the sacrifices were allocated among developed nations.[29]

The transfer payments alone create a significant burden. The MIT study describes the results of one scenario thusly:

> "This transfer might also be compared to market flows—purchases of allowances will become part of developed

> countries [sic] import bill. To maintain trade balance an increase in imports of permits would need to be balanced by a reduction of other imports or an increase in exports. For the US exports were about $120 to $155 billion per month in 2007-08. Assuming US exports maintained the same relation to (projected) GNP, they would rise to $175 to $225 billion per month in 2020, and $385 to $500 billion in 2050. The US purchase of allowances in those years (taking *Full comp-equal cost* as an example) would require a 10% to 13% increase in exports in 2020 to maintain trade balance, and 29% to 37% in 2050."[30]

These are very large policy-imposed challenges. And they would be imposed on top of the already daunting post-bubble economic challenges to save, produce, and export more. If successfully met, these climate challenges would only restore the US economy to the condition of the *status quo ante*.

These factors would not preclude an agreement in which the US incurred substantial costs in the service of GHG controls. They do suggest that a GHG control agreement in which the US incurs large costs to reduce Chinese GHG emissions may not be politically sustainable.

## *The risks of exaggerating Chinese efforts on GHG reduction*

America has reason to applaud Chinese actions to reduce GHG discharges. This is true even if those actions are of modest significance. At the same time, China has valid reasons to pursue efficiency gains. It may well also have opportunities for some profitable use of renewables. These innovations might produce some GHG reductions. The carbon efficiency of the Chinese economy has been very low. Countless options exist, no doubt, for improving it. Perhaps, many of these could produce net benefits quite independently of any concerns about climate.[31] The Chinese, therefore, have an incentive to make these no-regrets changes while trumpeting them as a sign of good intentions on GHG control.

Some advocates, however, may be tempted to pretend to accept some mix of these Chinese policies and measures as constituting serious action on GHG controls. This willing suspension of disbelief might offer short-run advantages in the task of enacting domestic GHG controls. In the long-run, though, it is dangerous climate policy.

Deep US emission cuts will not be cheap. If they do not produce comparable responses from many fast-developing countries, their impact on climate will be small. For the reasons discussed above, they are unlikely to elicit this response. If they do not, there is a real chance of the US policies being perceived as failures. (Indeed, they most likely would be failures in the sense of producing costs in excess of their benefits.) The last thing that climate policy needs at this point is for America to lurch into hasty GHG reductions and then reverse course when the discovery dawns that other key players have no intention of copying its actions.

## A realistic approach to American climate policy

To all appearances, then, a policy of idealistic leading by example on GHG reductions is a risky one. Yet few people at this point would propose to ignore the looming worries about climate change. There is no good alternative to attempting to devise an active climate policy but one that can be pursued within our great, but limited, national means.

### *The need to set a realistic pace for GHG reductions*

A GHG control policy is unlikely to succeed until China, India, and many other fast-developing countries become willing to shoulder a substantial share of the costs. The passage of time is likely to increase these countries' willingness to pay. In the past, as countries have become wealthier, they have been inclined to spend more on environmental quality, a tendency that economists have dubbed the environmental Kuznets curve. This tendency may well apply to China, India, and other similar states.

Also, over time, these nations may develop the legal infrastructure that would allow them to implement more cost-effective forms of GHG limits. Today, they almost certainly could not implement a GHG tax or cap-and-trade scheme. Or, if they did, it might not produce the desired results.[32] Using command-and-control rather than market-based policies can, though, greatly increase the social costs of reaching a given level of GHG reduction.

Finally, new technology is likely, over time, to lower the costs of GHG control. This expectation is one reason that economically optimal GHG control scenarios concentrate emission cuts in the relatively distant future. For this reason, too, China and India are likely to be more willing to make GHG cuts later, when they can get larger returns for their investments.

### *Take the long view; new technology is central*

The high costs of GHG abatement, then, are one key source of climate policy's intractability. Only new technology can offer a way out of this difficulty. US climate policy should act on this insight. It should make the search for relevant new technology its top long-term priority.

This policy choice entails two initiatives. One is a modest carbon tax or, perhaps, a so-called hybrid cap-and-trade system. This measure would encourage the private sector to commercialize new low-cost technologies for abating GHG emissions. Keeping the GHG price low would limit the potential for competitive harm – even if America's trading partners failed to imitate its policy.

Credibility is another value of a modest and gradually increasing carbon price. The adoption of goals based on very steep GHG cuts is likely also to create a different source of unnecessary costs. Legislation that, if fully implemented, would lead to very high future costs may be greeted with skepticism. Investors might speculate that, when the

economic crunch arrives, future officeholders may relax the goals to avoid imposing high costs on influential constituents. In that case, businesses may well adopt a wait-and-see stance with regard to investments in new technology. The result would be to delay new technology's advance into the market rather than to speed it up.[33]

For a low price to have much effect on the course of technology, the controls must be as cost-effective as possible. In the case of GHG controls, a price-based system is more cost-effective than any other policy tool.[34] Thus, a modest carbon tax or, perhaps, a so-called hybrid cap-and-trade system, would be the best available policy tool for creating the desired price.

Achieving the needed large declines in abatement costs, though, will require more than a price on GHG output. Breakthroughs in basic science will be essential.[35] The private sector generally invests little in basic science, and GHG limits will not change that fact.[36] Some form of government support for basic science will be necessary to ensure that this investment occurs.[37]

Government has often been tempted to short-change basic energy science in favor of large demonstration projects. It has also found it difficult to avoid wasteful stops and starts in funding.[38] These challenges will doubtless reappear as government wrestles with the technological aspects of climate change. In the best of circumstances, the innovation process is likely to be a slow one. Prudence would seem to caution against expectations of sudden success.

## *Give priority to adaptation*

A substantial amount of climate change is inevitable. Past emissions have locked it into the climate system. Fortunately, much can be done to minimize the net social costs of this change. America is well-endowed with the resources required to make the needed adjustments.

Many of these adjustments can be left in the hands of the private sector and of state and local governments. They have strong incentives to undertake the needed changes. Today, though, they are hampered by lack of knowledge about how regional climates will change and on what time scale.[39] Generating and diffusing this kind of scientific knowledge should be a top priority of federal climate policy. Developing this knowledge will depend on a strong, non-ideological climate science program. New knowledge in this area would clearly boost the nation's long-term economic productivity.

The federal government may also need to reassess some of its own policies. For example, public subsidies to disaster insurance may promote too much private sector investment in high risk areas. Climate change could worsen the potential resource misallocations. This risk may merit further study. In other instances, federal policies may cause under-pricing of some water resources. Again, the prospect of climate change may well increase the value of the resources being misallocated. Issues like these occasion intense passions. Yet the scale of changes that these policy changes would entail is no greater than some of

those that GHG controls would impose on energy consumers, and the policy changes might yield net benefits rather than net costs.

A family of technologies, known collectively as 'geoengineering', might provide an added tool for adaptation. The idea behind them is simple. When sunlight strikes the Earth's surface, greenhouse gases in the atmosphere trap some of the heat that is generated. A slight decrease in the amount of sunlight reaching the Earth's surface could, in principle, offset the warming. Scientists estimate that deflecting relatively small amounts of the total sunlight that strikes the Earth back into space would be enough to cancel out the warming effect of doubling the pre-industrial levels of greenhouse gases.[40]

Scattering this amount of sunlight may be fairly easy. Past volcanic eruptions have shown that injecting relatively small volumes of matter into the upper atmosphere can scatter enough sunlight back into space to cause discernable cooling. The 1991 eruption of Mt. Pinatubo reduced global mean temperature by about .5 degrees Celsius. This temperature reduction was apparent in just a few months and persisted for about three years.[41]

Some scientists propose, therefore, to use modern technology to create a carefully engineered analogue to this effect. Proposals to seriously study geoengineering are gaining adherents among climate policy experts. In late 2006, NASA and the Carnegie Institution jointly sponsored a high-level expert workshop on the subject. The workshop report observed that such distinguished scientists as Ralph Cicerone, Paul Crutzen, and Tom Wigley and prominent economists such as William Nordhaus and Thomas Schelling have long argued that the concept warranted further exploration.[42] Recently, an expert conference conducted at Stanford added the voices of several more distinguished economists to those who have called for further research on this option.[43]

## *Seek international agreements where real agreement exists*

For climate policy, domestic and international initiatives are both required, and they must be mutually supportive. Thus climate diplomacy should support the kind of initiatives that have just been described. In general, the United States will doubtless engage other nations on climate change. More than a few opportunities exist for useful agreements. It is just that a global pact on GHG caps with full trading of emission allowances is almost certainly not among them.

In the meantime, though, many options for climate-related agreements do remain. On GHG controls, for example, a "targets and timetables" approach within a "pledge and review" framework would seem to make monitoring compliance much easier. This approach would also make penalties of failing to perform agreed actions more credible.[44] Attempts to agree to limited GHG controls of this type might make progress where the more ambitious GHG control plans are doomed to fail. (The downside is that the reductions that they achieve are likely to be small compared to the demands of the most zealous proponents of steep cuts.)

Prospects for technology cooperation may also be good. In addition, the US may wish to coordinate with other industrialized nations in order to help to boost the adaptive capacity of poorer states. It is realistic to pursue these opportunities, and doing so may yield economic, humanitarian, and security benefits.

## Conclusion

In conclusion, America needs an activist climate policy, but it also needs a realistic one. Climate change is a serious concern, but it is not our only one, nor even the most pressing. Our responses need to account for the limitations on our resources and our abilities to affect the preferences of other societies.

Realism demands a willingness to engage in hard bargaining, and bargaining, as always, requires an ability to look beyond what others say in order to measure their deeds and to assess their interests. It also requires patience. These qualities are important. If we neglect them, the American people will pay more than they need to and get less climate protection than they could have.

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# APPENDIX A

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## A Statement on the Appropriate Role for Research and Development in Climate Policy*

**Kenneth J. Arrow, Linda Cohen, Paul A. David, Robert W. Hahn, Charles Kolstad, Lee Lane, W. David Montgomery, Richard R. Nelson, Roger Noll and Anne E. Smith**

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# REG-MARKETS CENTER

AEI Center for Regulatory and Market Studies

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## Executive Summary

A group of economists and scientists met at Stanford University on October 18, 2008 to discuss the role of research and development in developing effective policies for addressing the adverse potential consequences of climate change. We believe that climate change is a serious issue that governments need to address. We also believe that it is vitally important that research and development be made a central part of governments' strategies for responding to this challenge.

## A Statement on the Appropriate Role for Research and Development in Climate Policy

A group of economists and scientists met at Stanford University on October 18, 2008 to discuss the role of research and development (R&D) in developing effective policies for addressing the adverse potential consequences of climate change. We believe that climate change is a serious issue that governments need to address. We also believe that research and development needs to be a central part of governments' strategies for responding to this challenge. Solutions to manage long-term risks will require the development and global deployment of a range of technologies for energy supply and end-use, land-use, agriculture and adaptation that are not currently commercial. A key potential benefit of focused scientific and technological research and development investment is that it could dramatically reduce the cost of restricting greenhouse gas emissions by encouraging the development of more affordable, better performing technologies.

Broadly speaking, economists identify three ways in which government can constructively address climate change. One is by pricing the damages caused by emissions leading to climate change. Doing so would induce individuals and firms to take better account of these damages in their everyday decisions. A second is through government research and development policy aimed at stimulating the search for new knowledge that could lead to breakthroughs in greenhouse gas reducing technology. A third is by taking and encouraging actions that would reduce the damage caused by greenhouse gas emissions. Here too, R&D can contribute by addressing technological means of damage-mitigation, including adaptation and geo-engineering. However, governments' support for technology R&D should cease at the development stage or in select cases the pilot demonstration phase. Risks and rewards from commercial deployment should be left for markets to determine, including, of course, whatever additional price signals arise from market-based mitigation policies.

The group agreed to the following set of principles as a guide to the design of an effective research and development policy for addressing climate change.

**The need for R&D policy in addition to cap and trade, tax, standards or other policies to reduce emissions**

- An effective strategy to deal with greenhouse gas emissions requires that individuals and firms have incentives to take action to reduce their emissions. However, adequate control of greenhouse gas emissions almost certainly will require policies beyond pricing greenhouse gas emissions (or regulatory policies with the same end) and needs to include significant levels of direct and indirect support for basic and applied R&D.
- The payoff from effective R&D to reduce the cost of lowering greenhouse gas emissions could be very high.

**The need for stable, long-term commitment to R&D support**

- Policy commitments must be stable over long periods of time. Climate change is a long-run problem and will not be solved by transitory programs aiming at harvesting available short-run improvements in energy efficiency or of low-carbon energy. A much more stable commitment to funding and incentives for R&D is required to do better than the limited results of energy R&D efforts in the 1970s and 80s.
- Businesses and consumers must have credible and appropriate incentives for innovation if they are to develop new technologies that will be needed to mitigate and adapt to climate change. Challenges include providing adequate funding for basic and fundamental research, encouraging risk-taking, and promoting open access to information.
- Stable long-term commitments to R&D funding and incentives will change the direction of R&D.
- Among the steps governments need to consider in addressing such a long-term challenge are not just those that apply existing capabilities to climate-related research today, but also those that build the fundamental capacity to perform research in the future. This could include steps to promote training of scientists and engineers, rejuvenate laboratory capabilities in universities, and to establish programs to disseminate research information for example through internships, post-doctoral fellowships and exchange programs both nationally and internationally.

**Design of R&D programs**

- Government R&D policy should encourage more risk-taking and tolerate failures that could provide valuable information. This can be accomplished by adopting parallel project funding and management strategies and by shifting the mix of R&D investment towards more “exploratory” R&D that is characterized by greater uncertainty in the distribution of project payoffs.
- The single greatest impediment to an R&D program that is directed at achieving a commercial objective is that it will be distorted to deliver subsidies to favored firms, industries, and other organized interests. The best institutional protections for minimizing these distortions are multi-year appropriations, agency independence in making grants, use of peer review with clear criteria for project selection, and payments based on progress and outputs rather than cost recovery.

- Technological progress requires both R&D and learning, so that R&D programs should not be planned in isolation from practical application. R&D can be required to make even a relatively well-developed technology suitable for particular applications, and attempts to make practical use of a technology can reveal points where additional R&D would be most productive.
- Climate change cannot be halted without technologies that are applicable to developing countries. Developing these technologies and facilitating their adoption will likely require engagement of R&D networks in developing countries.
- Research on how societies can better adapt to the effects of climate change and research on geoengineering as a measure to moderate temperature increases and climate impacts should be included in a complete research portfolio.

**The limited role of technology standards and subsidies**

- Mandates and subsidies aimed at supporting the deployment of relatively mature technologies are unlikely to be cost-effective tools for eliciting the major reductions of greenhouse gas emissions that now appear to be called for. In some cases, performance standards have proven effective in promoting engineering improvements and the wider adoption of existing techniques. Since the process of technology innovation and diffusion can require an extended period of time, performance standards with shorter compliance periods cannot be expected to stimulate major breakthroughs.
- Technology-forcing performance standards have had a mixed record in inducing innovation. Regulators can find it difficult to obtain information about the status of technologies that is accurate enough to allow them to set standards that both can be achieved and will induce real innovation. Such standards may be effective when the path to a technological solution is reasonably clear, but are less likely to be effective in stimulating cost-effective and broad-based breakthrough technologies. This is especially relevant in dealing with a multi-decadal issue such as climate change, where the challenge is to evolve standards with time in light of new knowledge and experience.


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