CARBON DIOXIDE AND METHANE EMISSIONS

The emissions policy submodule, part of the integrating module, estimates the energy–related emissions of carbon dioxide and methane. Carbon dioxide emissions are dependent on the fossil fuel consumed, the carbon content of the fuel, and the fraction of the fuel consumed in combustion. The product of the carbon dioxide coefficient and the combustion fraction yields a carbon dioxide emission factor. For fuel uses of fossil energy, the combustion fractions are assumed to be 0.99 for liquid fuels and 0.995 for gaseous fuels. The carbon dioxide potential of nonfuel uses of energy, such as asphalt and petrochemical feedstocks, is assumed to be sequestered in the product and not released to the atmosphere. The coefficients for carbon dioxide emissions are updated each year from the Energy Information Administration's annual, *Emissions of Greenhouse Gases in the United States*.[17]

The energy-related methane emissions are estimated as a function of energy production and consumption drivers. Methane emissions occur in various phases of the production and transportation of coal, oil, and natural gas. Additional emissions occur as a result of incomplete combustion of fossil fuels and wood. The methane equations in NEMS are derived from methodologies and data sources in Energy Information Administration's annual *Emissions of Greenhouse Gases in the United States*.[18]

The emissions policy submodule also allows for several carbon dioxide policy evaluation options to be analyzed within NEMS. Although these policy options are not assumed in the Annual Energy Outlook, the options have been used in special analyses to simulate potential market–based approaches to meet national carbon dioxide emission objectives. The policy options implemented are as follows:

- *Carbon Dioxide Tax*. A tax on carbon dioxide emissions from fossil fuels is added to raise delivered fossil fuel prices. The resulting higher prices then induce changes in fossil fuel use and carbon dioxide emissions, as well as

changes in some long–term decision making, such as generating capacity decisions in the electricity market module.

- *Auction of Permits*. This option simulates an auction on carbon dioxide emissions permits to meet an overall cap on emissions. A carbon dioxide permit price is computed that clears the auction market. The permit fee is treated as a carbon dioxide tax and used as an adjustment to the fossil fuel prices. A new price is set each NEMS iteration until the emissions reach the goal. The revenue generated from the auction is calculated assuming there is no initial allocation of emission permits.

- *Market for Permits (Cap and Trade)*. A market for tradable carbon dioxide emissions permits is simulated assuming that an initial distribution of marketable permits to emission sources takes place. The permits are transferable but are not banked between years. As with the carbon dioxide tax and auction options, the full market price of the permits is added to the energy prices. The system of marketable permits is implemented in the same way as the permit auction, with the exception of the calculation of revenues from permit sales. Similar treatment is warranted because the marginal cost of a free permit is equivalent to one purchased at auction, given the opportunity cost of holding the distributed permit.[19]

The options above can be implemented for all consuming sectors of NEMS or for the electricity generating sector alone. The use of any of these emissions policy options in NEMS requires a macroeconomic analysis to assess the fiscal and monetary issues, as well as the possible international trade effects. The analysis depends on such factors as how revenues generated from the policy would be used, how monetary authorities would react to the fiscal policy

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[17] Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001,* DOE/EIA-0573(2001) (Washington, DC, December 2002).

[18] Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001,* DOE/EIA-0573(2001) (Washington, DC, December 2002).

[19] In an open, competitive permit market, the permit will tend to be priced at the marginal cost of reducing carbon dioxide emissions, regardless of the initial distribution of permits. If permits are purchased by suppliers and passed through to the fuel price, the marginal cost of the carbon dioxide emissions by a particular sector in a region will be reflected in the individual end–use fuel cost for tht sector.

changes, and how international agreements to re-duce carbon dioxide emissions would be imple-mented.

A limitation of these policy options is that they ad-dress energy–related carbon dioxide emissions only.

Work on NEMS is underway on a capability to esti-mate reductions of other greenhouse gas emissions. This capability, drawing on marginal cost of abate-ment curves for such gases, will enahle the economic analysis of policies targeted at capping total green-house gases in an internally consistent framework.