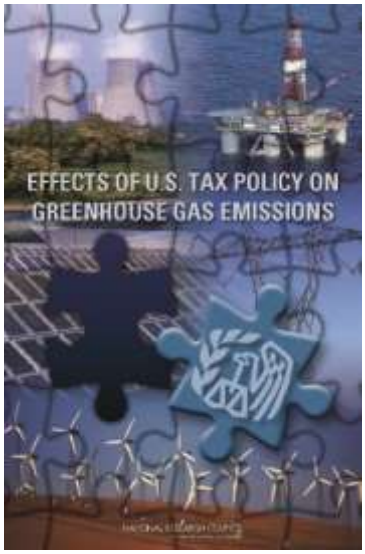
NATIONAL ACADEMY OF SCIENCES
NATIONAL ACADEMY OF ENGINEERING
INSTITUTE OF MEDICINE
NATIONAL RESEARCH COUNCIL



EFFECTS OF U.S. TAX POLICY ON GREENHOUSE GAS EMISSIONS (2013)

The Study's Origin

In the context of ongoing debates about budget deficits and tax reform, climate change, and national energy policy, Congress asked the National Academies to review the entire Internal Revenue Code and identify the tax provisions that produce the largest increases or reductions in greenhouse gas (GHG) emissions and to estimate the magnitude of those effects (P.L. 110-343, Division B, Title I, Sec. 117). The Academies were not asked to take positions for or against specific task provisions, which may serve several purposes, but were encouraged to provide general guidance on the use of tax policy to address climate change. The Academies assembled a committee of experts in tax policy, economics, climate science, environmental law, and energy and climate modeling to undertake this task.

Principal Finding

Current federal tax provisions have little net effect on GHG emissions. The combined effect of energy-related tax subsidies for renewable sources and fossil fuels is very small, probably less than 1 percent of U.S. emissions, and could be either positive or negative. Estimating the precise impacts of tax policy is difficult because of the complexities of the code, the interaction of taxes and regulations, and the limitations of current economic models.

How the Study Was Done

Because the tax code changes from year to year through congressional action and expiring provisions, the committee chose the 2011 code as its baseline. The committee made other baseline assumptions about GDP growth, oil prices, and regulations. Next, the committee made a preliminary selection of tax provisions to study based on several criteria – close association with energy production and consumption (the largest source of domestic GHG emissions), large revenue consequences, and large effects on patterns of output and consumption across the economy. The energy-related provisions included excise taxes on highway motor and aviation fuels as well as tax subsidies for biofuels, electricity production from renewable resources, and oil and gas production. The committee also selected broad-based provisions with potentially large indirect effects on GHG emissions including the tax breaks for owner-occupied housing and employee-sponsored health insurance and incentives for capital investment through accelerated depreciation of industrial machinery and equipment.

The committee undertook a wide-ranging search for research on the effects of these tax provisions and found almost no literature directly addressing their impact on GHG emissions. Given the paucity of existing research and the need to use a uniform set of baseline assumptions, the only feasible strategy available to the committee was to conduct original analysis of specific tax code provisions using established energy-economic models, most of them subject to frequent peer review and well known to the government.

No single model was found to be suitable for analyzing all of the tax provisions, however. In the end, the committee chose four independent modeling groups to perform the work. [1] The modeling runs compared the baseline (all of the 2011 provisions in effect) with scenarios that removed each provision one at a time and estimated their economic and emissions-related effects over a relatively long period, usually 2010 to 2035. All of the models used have limitations for this purpose. In a few cases, tax provisions the committee thought might be important – such as home energy efficiency credits – could not be analyzed quantitatively by any of the models. And in general the committee cautions against relying on specific numerical results from a single model and recommends drawing only broad conclusions about the nature and direction of emissions impacts. The provisions studied are listed in the following table, along with their revenue consequences and GHG emissions effects.

Provisions Modeled for the Study

	Revenue Effect (FY 2010, $ billions)	GHG Effect (2010-2035 unless otherwise noted)
Energy Excise Taxes		
Highway motor fuels excise tax	25.1	decrease
Aviation fuel excise tax	0.4	decrease
Energy-related tax expenditures		
Production tax credit for renewable energy	(3.9)	decrease
Excess of percentage over cost depletion for oil and gas wells	(0.98)	minimal impact
Biofuels Provisions (2014-2021)		
Volumetric ethanol excise tax credit	(5.75)	increase
Biodiesel excise tax credit	(0.51)	no impact or increase
Broad-based tax expenditures		
Home mortgage interest deduction (and other housing incentives)	(79.1)	uncertain
Exclusion of employer-provided health insurance and other health care subsidies	(160.1)	uncertain
Accelerated depreciation	(39.8)	increase

Specific Results of the Commissioned Modeling Studies

Despite the difficulties of the analysis, the committee drew the following conclusions:

- **Individual tax expenditures for the energy sector in some cases contribute to and in other cases subtract from U.S. or global GHG emissions.** Tax subsidies on ethanol production, some of which expired at the end of 2012, clearly increased greenhouse gas emissions by lowering fuel prices and encouraging consumption and through changes in land use On the other hand, the production and investment tax credits for renewable sources of electricity clearly reduce emissions although by a small amount and at a fairly high cost in foregone revenue. The effect of the depletion allowance for oil and gas production is close to zero.
- **Energy excise taxes (on motor vehicle and aviation fuels) reduce greenhouse gas emissions, but the magnitude of the reduction is most likely quite small, in part because the taxes are based on volume rather than energy content**.
- **The federal tax revenue foregone as a result of energy-sector tax subsidies is substantial compared to these subsidies' small (or even counter-productive) effects on greenhouse gas emissions.** The U.S. Treasury estimates that the revenue loss from energy-sector tax expenditures in fiscal years 2011 and 2012 totaled $48 billion.

[1] The four groups were: OnLocation, Inc. of Vienna, VA, using the Energy Information Administration's National Energy Modeling System (NEMS); The Food and Agricultural Policy Research Institute at the University of Missouri using its own FAPRI model; Dale Jorgenson Associates using its Intertemporal General Equilibrium Model (IGEM); and The Center for Business and Economic Research (CBER) at the University of Nevada, Las Vegas using its own model.

- **The impact of the broad-based tax expenditures (for housing and health care) on total greenhouse gas emissions is primarily through their effect on economic output.** Where removing a tax break increased economic efficiency and output, for example, greenhouse gas emissions rose by a comparable amount. But the economic and GHG impacts are highly dependent on assumptions about what is done with the higher tax revenues.
- **The impact of the broad-based tax expenditures on greenhouse gas emissions intensity (emissions per unit of economic output) is difficult to estimate.**
- **The effects of many tax provisions are complicated by their interactions with regulations such as the renewable fuels standards, the fuel-economy standards for automobiles, air pollution standards, and the renewable portfolio standards for electricity generation.** Regulations and mandates reinforce the effects of tax provisions in some cases and offset them in others.
- **The best existing analytical tools are unable to determine in a reliable fashion the impact of some important tax expenditures.** Important variables that have been difficult to integrate into the analysis include the discount rate consumers apply to future fuel savings, the strength of any rebound effect, and the extent to which consumers respond to changes in tax laws.

Recommendations for Future Modeling Efforts

Existing economic models, including those commissioned in this study, have numerous shortcomings. Modeling needs to be improved in the following ways:

- Models should be made more transparent and incorporate more clearly-defined assumptions and structures.
- Models should include measures of economic welfare in order to better measure the efficiency and equity of policies.
- Partial-equilibrium (sector-specific) models need to be more effectively linked to general-equilibrium (economy-wide) models in order to estimate more reliably the effects of tax revenue recycling along with tax provisions' overall economic impacts.

Guidance on Use of Tax Policy to Address Climate Change

The committee reached the following conclusions about tax policy as a tool for climate change mitigation:

- C**urrent taxes and tax subsidies are a poor tool for reducing greenhouse gases and achieving climate-change objectives, although some energy expenditures are more efficient than others.**
- **The committee's reservations about the use of tax expenditures and subsidies to affect greenhouse gas emissions do not necessarily apply to tax incentives targeted toward research and development on technological advances that will support the nation and world's transition to a low-carbon energy system.** The committee did not review these expenditures but noted the existence of a substantial body literature justifying tax subsidies for R&D.
- **Tax reforms that raise the efficiency of the economy may increase greenhouse gas emissions; but the increased output is likely to be much more than sufficient to pay for reducing the higher emissions through efficient climate-change policies.**
- **Many studies have found that the most reliable and efficient *w*ay to achieve internationally agreed-upon climate-change objectives is to use direct tax or regulatory policies that create a market price for carbon dioxide and other GHG emissions.** The national and global reductions in greenhouse gas emissions necessary to arrest global warming are many times greater than those resulting from current tax policies, even in modeling studies using the most favorable assumptions. To meet these objectives, a different approach is needed, one that targets greenhouse gas emissions directly.

COMMITTEE ON THE EFFECTS OF PROVISIONS IN THE INTERNAL REVENUE CODE ON GREENHOUSE GAS EMISSIONS: William D. Nordhaus, Chair, Sterling Professor of Economics, Yale University; **Maureen L. Cropper**, Professor of Economics, University of Maryland, College Park; **Francisco de la Chesnaye**, Program Manager and Senior Economist, Electric Power Research Institute; **Noah Diffenbaugh**, Center Fellow, Woods Institute for the Environment, Assistant Professor, School of Earth Sciences, Stanford University; **David G. Hawkins**, Director of Climate Programs, Natural Resources Defense Council; **Roberta F. Mann**, Frank Nash Professor of Law University of Oregon School of Law; **Brian C. Murray**, Research Professor and Director of Economic Analysis, Nicholas Institute for Environmental Policy Solutions, Duke University; **John M. Reilly**, Co-Director of Joint Program on the Science and Policy of Global Change, Senior Lecturer, Sloan School of Management, The Massachusetts Institute of Technology; **Drew Shindell**, Senior Scientist, NASA Goddard Institute for Space Studies; **Eric Toder**, Institute Fellow, Urban Institute, Co-Director, Urban-Brookings Tax Policy Center; **Roberton C. Williams, III,** Associate Professor, University of Maryland, College Park; and **Catherine Wolfram**, Flood Foundation Professor of Business Administration, Haas School of Business, University of California, Berkeley.
Project Staff: **Stephen A. Merrill**, Study Director; **Paul T. Beaton**, Program Officer; **Aqila Coulthurst**, Program Coordinator; and **Cynthia Getner**, Financial Officer.

The **Board on Science, Technology, and Economic Policy (STEP)** advises federal, state, and local governments and informs the public about economic and related public policies to promote the creation, diffusion, and application of new scientific and technical knowledge to enhance the productivity and competitiveness of the U.S. economy and foster economic prosperity for all Americans. The STEP board and its committees marshal research and the expertise of scholars, industrial managers, investors, and former public officials in a wide range of policy areas that affect the speed and direction of scientific and technological change and their contributions to the growth of the U.S. and global economies.

For more information or copies of this report, contact the Board on Science, Technology, and Economic Policy (STEP) at (202) 334-2200 or visit www.nationalacademies.org/step. Copies of *Effects of U.S. Tax Policy on Greenhouse Gas Emissions* are also available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.