COMPREHENSIVE TAX REFORM AND

U. S. ENERGY POLICY[1]

by

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1. Introduction and Executive Summary.

The CBO long-term budget outlook released one week ago presents the stark facts of our fiscal situation in its two benchmark scenarios.[2] The Extended Baseline scenario adheres closely to current law. This would allow the Bush tax cuts of 2001 and 2003 to expire and implement other budget changes that would raise revenues to 21 percent of the GDP by 2021 and cut spending. The Extended Alternative Fiscal scenario, an extrapolation of past budgetary policy, would raise revenues to 18 percent of GDP by 2021 and avoid the "fiscal cliff" facing the federal budget under the Extended Baseline. A separate study by CBO projects that the fiscal cliff could produce a new recession.[3]

Major tax changes are clearly in prospect, whether or not the Bush tax cuts are allowed to expire. This has led to consideration of comprehensive tax reform, the subject of this hearing. As an illustration, the Bowles-Simpson National Commission on Fiscal Responsibility and Reform submitted its report, *The Moment of Truth*, on December 1, 2010.[4] Chapter II calls for "comprehensive tax reform" and specifies that this should reduce tax rates, cut the deficit, and eliminate tax expenditures. Federal revenue would reach 21 percent of the GDP, higher than the long-term average of 19 percent of the GDP and well above the level of 17 percent for 2011.

A. Comprehensive Tax Reform. Comprehensive tax reform is overdue. The Tax Reform Act of 1986 is the last major legislation in this critical area of public policy. The

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[1] Prepared as written testimony for the Hearing on "Tax Reform: The Impact on U.S. Energy Policy," Committee on Finance, United States Senate, June 12. 2012.

[2] Congressional Budget Office (2012), *2012 Long-Term Budget Outlook,* Washington, DC, Congressional Budget Office, June. See: http://www.cbo.gov/publication/43288.

[3] Congressional Budget Office (2012), "Economic Effects of Reducing the Fiscal Restraint that Is Scheduled to Occur in 2013," Washington, DC, Congressional Budget Office, May. See: http://www.cbo.gov/publication/43262 See also: Ben S. Bernanke, "Economic Outlook and Policy," Testimony before the Joint Economic Committee, U.S. Congress, June 7, 2012. See: http://www.federalreserve.gov/newsevents/testimony/bernanke20120607a.htm

[4] National Commission on Fiscal Responsibility and Reform (2010), *The Moment of Truth,* Washington, DC, National Commission on Fiscal Responsibility and Reform, December. See: http://www.fiscalcommission.gov/news/moment-truth-report-national-commission-fiscal-responsibility-and-reform.

approach to tax reform recommended by Bowles and Simpson follows the path of the 1986 tax legislation. This would begin by eliminating all tax expenditures or "leveling the playing field". The Commission would use most of the revenue to reduce the deficit and lower tax rates, but part of the revenue would add back necessary tax expenditures. The Commission provides its own very short list and it is worthwhile to note that no tax expenditures on energy are included.

Tax expenditures on energy are among the possible revenue sources needed for comprehensive tax reform. However, an even more promising approach is a system of environmental taxes focused on combustion of fossil fuels. This would raise substantial tax revenue, almost 1.5 percent of the GDP, while producing large environmental benefits. Taxes on fossil fuels, carefully calibrated to their incremental effects on health and the environment, could replace the system of subsidies and tax preferences for energy conservation and renewable energy sources. This would sharply reduce our reliance on nonrenewable sources and clean up the environment, but at a much lower cost to the taxpayer and the economy.

B. Outline of My Testimony. In this testimony I will identify the issues in designing a new energy tax policy for the U.S. The most important of these is the "hidden cost" of energy, arising mainly from the health and other environmental costs of burning fossil fuels. I discuss these costs in Section 2. In Section 3 I outline the role of government policy in dealing with the failure of energy markets to absorb the hidden costs of energy. In Section 4 I describe a system of energy taxes that would remedy this market failure. These taxes would fall most heavily on coal, but would also involve taxes on oil and modest taxes on natural gas. The tax rates reflect empirical data on the health and environmental damages generated by fossil fuel combustion. These data were recently employed by a distinguished panel of environmental economists, engineers and scientists, convened by the National Academies in a Congressionally mandated study.

In Section 4 I discuss the hidden cost of climate change, which would affect the world economy as a whole, as well as the U.S. economy. Energy taxes should be designed to deal with the hidden costs of climate change as well as the health and environmental damages. The costs of climate change are similar to those for the six criterion pollutants identified by the U.S. Environmental Protection Agency, but much smaller in magnitude. In Section 5 I outline a system of environmental taxes that would combine these two sources. By dealing with the market failures identified in Section 3, energy taxes could clean up the environment and slow global warming. The revenue could close the budget gap and reduce tax rates as part of comprehensive tax reform.

Section 6 of my testimony considers policy alternatives to a system of energy taxes. Current energy policy includes substantial tax subsidies for nonrenewable energy. These subsidies are effective in reducing our dependence on fossil fuels, but are not *cost effective*, to use economic jargon. The costs vary dramatically from expensive tax subsidies to biodiesel fuels to relatively inexpensive subsidies to open-loop biomass. A cost-effective policy would minimize the costs of achieving a given environmental objective. The cost of an incremental reduction in the hidden costs of energy should be the same for all these policy options in order to minimize cost.

C. Conclusions. A system of environmental taxes would be very effective in dealing with the hidden costs of energy. We now have four decades of experience with the energy conservation that results from higher energy prices. In addition, energy taxes would be cost-effective. They would put renewable energy sources not subject to energy taxes onto a level playing field with the nonrenewable sources that will continue to provide a major part of our energy. Moreover, energy taxes would reflect the highly important differences in the hidden costs of energy associated with the combustion of coal, oil, and natural gas. In the stringent budgetary environment we will be facing for some time, we need to make cost-effective use of every one of the taxpayer's hard-earned dollars.

As an environmental economist, I will focus my testimony on saving money for the tax payer or cost effectiveness. I know that the Senate Finance Committee has already had extensive testimony from environmental experts who have attested to the technical efficacy of alternative policy instruments already in widespread use, such as production subsidies for renewable energy sources, energy standards, and mandates. These provide an expensive way of achieving the goals of environmental policy and have no role to play as a source of revenue to finance comprehensive tax reform. I believe that the economic perspective will offer a practical avenue for achieving a sustainable fiscal policy, the paramount economic and political issue facing this Committee and the nation.

2. Hidden Costs of Energy.

Developing and implementing a coherent energy policy for the United States has always been problematical. This arises from the fact that the production and use of energy is characterized by large and well-documented "external effects" or *effects that take place outside energy markets*. These are "hidden" from market participants, as suggested by the title of the recent and comprehensive review by the National Academies, *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use*.[5] Since our economic statistics depend largely on market transactions, these hidden effects are also invisible in our national accounts and other economic reports.

Given the challenges of observing the external effects of energy production and use, it is not surprising that the formulation of a coherent energy policy for the U.S. has proved to be very difficult. The U.S. government does not provide an official set of estimates of the external effects associated with energy, but we have official statistics on the "internal

[5] See National Research Council (2010), *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use,* Washington, DC, National Academies Press. This report was mandated by the Energy Policy Act of 2005 and can be downloaded from the NAP website: http://www.nap.edu/catalog.php?record_id=12794. The report was produced for a National Academies "consensus" study by the Committee on Health, Environmental and Other External Costs and Benefits of Energy Production and Consumption, chaired by Jared L. Cohon, President of Carnegie-Mellon University and a distinguished environmental engineer. The panel included leading environmental economists, engineers, and scientists and the report was reviewed by a number of other scholars in these fields, including the author of this testimony.

effects" reflected in market transactions, such as energy prices and quantities, production and consumption of energy and its distribution by households and industries. Much of this is produced by the Energy Information Administration, a highly respected statistical agency within the U.S. Department of Energy.

A. Information on Hidden Costs. Despite the lack of official statistics, it is important not to exaggerate the difficulties in documenting and using information on the external effects of energy. The U.S. Environmental Protection Agency generates a great deal of information on the external effects of energy as well as many other products that create health and environmental hazards. A recent example is the study, *Benefits and Costs of the Clean Air Act: Second Retrospective Study – 1990 to 2020*, issued in March 2011.[6] This Study is devoted mainly to the external effects of energy relevant to the evaluation of the impact of the Clean Air Act of 1970 and the Clean Air Act Amendments of 1990.

The hidden effects of energy are also an active area for investigation by economists. This work has recently been summarized by Nicholas Muller, Robert Mendelsohn, and William Nordhaus in their paper, "Environmental Accounting for Pollution in the United States Economy".[7] The methodology employed in this important paper is also used by the NRC in *Hidden Costs of Energy* and the EPA in the *Second Retrospective Study*. This information can be used for designing energy policies, including energy taxes, that would enable markets to internalize the external effects of energy production and use. However, current energy policies are far from the economist's ideal, as I will try to demonstrate in this testimony.

3. The Role of Government Policy.

In the absence of external effects the traditional role of government would be to maintain competitive and smoothly functioning energy markets. However, energy production, especially for oil and coal, is carried out around the globe, not just in the United States, and involves a substantial portion of our international trade. This creates important issues for national security. In addition, the production of energy is itself subject to hidden costs, as the on-going controversy over the environmental effects of hydraulic fracturing or "fracking" reminds us. Extraction of coal involves large impacts on the areas where coal deposits are found, as in many of the states represented on the Senate Finance Committee.

A. Depletion Costs. The major source of energy in the U.S. and the world economy is fossil fuel combustion. This gives rise to many of the external costs that I have mentioned, but also raises the issue of depletion of nonrenewable resources. Is this another market failure that should be remedied by government intervention? An

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[6] U.S. Environmental Protection Agency (2011), *Benefits and Costs of the Clean Air Act of 1970: Second Retrospective Study – 1990 to 2020*, March.

[7] Nicholas Z. Muller, Robert Mendelsohn, and William Nordhaus (2011), "Environmental Accounting for Pollution in the United States Economy," *American Economic Review,* Vol. 100, No. 3, August, pp. 1649-1675. The American Economic Review is the leading journal in economics and recently celebrated its 100th year of publication.

alternative view is that the costs of depletion are fully internalized in markets for depletable resources such as coal, natural gas, and petroleum. Oil prices have risen substantially over the past decade, culminating with the petroleum price spike in July 2008. Many economists would support the position that markets have been successful in internalizing future depletion costs. The mechanism is through a rising gap between the price of energy paid by consumers and the costs of production and distribution of energy.

From the economic point of view depletion costs arise from sacrificing the opportunity to hold resources until their prices rise. On this view the costs of depletion are not hidden and do not constitute a market failure. While standard in resource economics, this view is rejected by many environmentalists and some economists. The list of tax expenditures for energy provided by the Joint Committee on Taxation includes numerous measures intended to provide incentives for energy conservation. These are motivated in large part by the view that depletion is not successfully internalized by the price system.

B. New Technologies. A final source of important hidden effects is the spillover effects of new technologies. These include technologies for producing usable energy services from renewable sources such as solar and wind. Information produced by the development and implementation of new technologies is difficult to appropriate. This information "spills over" to businesses and individuals not involved in creating the technologies. This creates a market failure leading to a deficient supply of new knowledge. For example, when a new product to generate solar energy reaches the market, third parties can "reverse engineer" the product and produce a similar one without investing in research and development. This market failure is often used to justify tax expenditures like the Section 45 and Section 48 credits for production from renewable sources of energy.

New technologies are very important to energy production. Rapid improvements in these technologies are the basis for the lengthy downward trend in real energy prices that continued for more than a century prior to the recent surge in energy prices. Obviously, technological innovation is not limited to renewable resources. The energy sector is now undergoing a striking transformation as a consequence of the introduction of hydraulic fracturing for the production of oil and gas and other new technologies, including deep water drilling. As a consequence of new technologies U.S. domestic production of natural gas has risen dramatically, resulting in powerful downward pressures on natural gas prices.

C. Tax Incentives for Energy Production. Long-standing tax incentives have played a role in the development of new technologies for oil and gas production. These include the expensing of exploration and development costs and the excess of percentage over cost depletion permitted under the Internal Revenue Code. However, the marked increase in energy prices over the past decade, especially oil prices, has been a more potent source of incentives for the deployment of new technologies. Domestic crude oil prices in April of this year were more than seven times as high as in December 1998.[8] These price

[8] Energy Information Administration, *Petroleum and Other Liquids, Cushing, OK, WTI Spot Price FOB.* See: http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RWTC&f=M

increases alone should motivate a thoughtful re-examination of tax expenditures for fossil fuel production.

Specific tax incentives are provided by the U.S. for renewable energy sources such as solar and wind. The growing market penetration of renewable energy is impressive and the decline in costs associated with improvements in these technologies has been substantial. However, much of this decline is due to equipment production in Europe and Asia, especially China, rather than the United States. The U.S. will continue to benefit from declines in the price of this equipment. The use of tax incentives to reinforce the decline in equipment prices seems redundant and will be increasingly difficult to justify as budgetary pressures for more tax revenue and less govenment spending increase.

Finally, exploration and development of nonrenewable resources creates a depletable asset, but is part of the cost of production, not the cost of depletion. Accordingly, costs of exploration and development should be treated like any other investment and subjected to depreciation, rather than depletion. Expensing these costs under U.S. tax law has the effect of removing this form of investment from the tax system. This is one reason that the expensing of these costs is treated as a tax expenditure by the Joint Committee on Taxation. For example, an oil well should be depreciated over the typical lifetime of a producing facility, perhaps ten years. I conclude that tax expenditures for energy production are ripe for reconsideration.

4. Market Failures and Energy Utilization.

I next consider market failures associated with the utilization of energy. The most important of these are associated with the hidden costs of environmental pollution. The textbook example of these costs is a power plant that emits smoke as a byproduct of production. This smoke is dispersed to the surrounding population and components find their way into people's lungs, resulting in disease and premature death. By imposing a tax on emissions, producers have an incentive to reduce the emissions and the environmental damages that result. Failure to restrict emissions produces an inefficient outcome. As an example, Muller, Mendelsohn, and Nordhaus estimate that environmental damages for coal-fired power plants in the U.S. is more than double the value added by these plants.[9]

The current system of tax incentives is not a cost-effective policy for dealing with environmental externalities. For example, the Joint Committee on Taxation (2012) has estimated that existing energy production tax credits would require amounts varying from $1.13 for open-loop biomass such as agricultural and wood waste to $8.45 for biodiesel fuels to replace a million btu's of heat energy from fossil fuel combustion.[10] By substituting the cheapest of these sources for the most expensive, each million btu would generate $7.32 to reduce the federal deficit or finance a reduction in tax rates. A cost-

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[9] See Muller, Mendelsohn, and Nordhaus (2011), Table 2, p. 1665. "Value added" is the value of all capital and labor inputs used in power production.

[10] Joint Committee on Taxation, *Present Law and Analysis of Energy-Related Tax Expenditures* (JCX-28-12), March 23, 2012, Table 1, page 27. See: www.jct.gov.

effective policy for reduction of fossil fuel use would have the same price for every source.This is a perfect illustration of the consequences of attempting to design energy and environmental tax preferences without using the information employed by the Environmental Protection Agency in its *Second Retrospective Study* and the National Research Council in *Hidden Costs of Energy*.

5. The Role of Energy Taxes.

A cost-effective policy for dealing with the hidden costs of energy requires that all users of fossil fuels, firms and households, bear the incremental cost of the health and environmental damages that result. This can be achieved by levying taxes on emissions that would be equal to the incremental health and environmental damages that result. These taxes would be cost-effective, since every user of energy would face the same taxes for the emissions resulting from all forms of energy. There would be no opportunities for reducing the cost of pollution control by shifting the cost among alternative energy sources.

Environmental taxes would be levied on emissions of EPA's six criterion air pollutants from fossil fuel combustion. These are coarse particulate matter or smoke, fine particulate matter, also from smoke, sulfur dioxide, nitrogen oxides, volatile organic compounds, and ammonia. Muller and Mendelsohn (2009) have designed a system of taxes based on these emissions,using the same data on the hidden costs of energy as in their work with Nordhaus.[11] One of the results of empirical studies of the hidden costs of energy is that pollution is greatest in relationship to heat production for coal, next greatest for petroleum products, and least for natural gas.[12]

A. Cost of Climate Change. Another important environmental externality is cost of climate change. This arises from the release of fossil fuel byproducts, such as carbon dioxide, into the atmosphere. These gases absorb heat radiated by the earth's surface; some of this heat is radiated back to the earth's surface, resulting in global warming. Climate scientists refer to this as the "greenhouse effect" and refer to gases that absorb heat and radiate it back to the earth as "greenhouse gases". Since carbon dioxide is the most important greenhouse gas, emissions of greenhouse gases are often converted to their equivalent amounts of carbon dioxide in terms of radiation.

Nordhaus (2009) has quantified the addtion to energy taxes that would be required to internalize the hidden costs of energy due to global warming.[13] The greenhouse gas content of fossil fuels that gives rise to global warming is highly correlated with emissions of the criterion pollutants. Coal has the highest carbon dioxide content per unit

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[11] Muller, Nicholas, and Robert Mendelsohn (2009), "Efficient Pollution Regulation: Getting the Prices Right," *American Economic Review,* Vol. 99, No. 5, December, pp. 1714-1739.

[12] National Research Council (2010), *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use,* Washington, DC, National Academies Press, Table 7.3, page 361. See: http://www.nap.edu/catalog.php?record_id=12794.

[13] Nordhaus, William (2009), *A Question of Balance: Weighing the Options on Global Warming Policies,* New Haven, CT, Yale University Press.

of heat production, oil has the next highest content, and natural gas the least. A system of environmental taxes on fossil fuel combustion would generate both health and environmental benefits and also reduce the contribution of this combustion to global climate change. It is important to emphasize that a cost-effective energy policy must include benefits of both types.

B. Climate Change and the Criterion Pollutants. Enthusiasts for measures to limit global warming sometimes advocate a carbon tax in the absence of environmental taxes for EPA's criterion air pollutants. The benefits that accrue from reduction in conventional pollutants are then treated as "ancillary" to the control of emissions of greenhouse gases. However, Muller and Mendelsohn (2009) show that the design of a system of energy taxes should include both costs. This approach is also used by the National Research Council in quantifying the *Hidden Costs of Energy* and by EPA in the *Second Prospective Study*. My conclusion is that both costs should be included in the design of energy taxes.

To illustrate the order of magnitude of energy taxes that would be appropiate for a system like that I have described, I have updated a report that I completed for the Environmental Protection Agency on the role of energy taxes in tax reform.[14] In 2011 the tax on coal would have been $108.07 per short ton of coal, $16.30 per barrel of oil, and $0.55 per thousand cubic feet of natural gas.. This would be 223.47 percent of the coal price to consumers, 11.51 percent of the petroleum price, and 8.05 percent of the price of natural gas. There would be no taxes on renewable sources of energy, such as wind and solar. These prices reflect the incremental health and environmental damages associated with fossil fuel combustion. The total revenue would be 1.5 percent of the GDP in 2011 or 75 percent of the gap between federal revenues of that year of 17 percent of the GDP and the long-term average of 19 percent.

6. Alternatives to Energy Taxes.

In this testimony I have emphasized that energy tax policy has an important role to play in comprehensive tax reform. However, the most important instruments of tax policy are those that relate to the use of energy, rather than energy production. Environmental taxes on energy use are designed to remedy a market failure due to hidden costs arising from environmental pollution. These costs are well-documented and have been carefully studied by the Environmental Protection Agency, the National Research Council, and environmental economists. One alternative to environmental taxes is a cap-and-trade system, like the one used for sulfur dioxide in the United States since the Clean Air Act Amendments of 1990.[15]

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[14] Dale W. Jorgenson, Richard J. Goettle, Daniel E. Gaynor, Peter J. Wilcoxen,, and Daniel T. Slesnick (1995), "Social Cost Energy Pricing, Tax Recycling, and Economic Change," Prepared for the Energy Policy Branch, Office of Policy, Planning, and Analysis, U.S. Environmental Protection Agency, August. This is not an official report by EPA and has not undergone the review process required for such a report. I am indebted to my co-author Richard Goettle for undating this work to provide the incremental damage estimates and the implied tax rates.

[15] A history of the Clean Air Act Amendments and an analysis of their economic impact, see: Chan, Gabriel, Robert Stavins, Robert Stowe, and Richard Sweeney (2012), "The SO2 Allowance Trading System and the

A. Cap-and-Trade. A cap-and-trade system for greenhouse gas emissions is employed in the European Union Emission Trading Scheme. Under this system emissions permits are issued up to a "cap" and market participants are then allowed to trade permits until the cost of emissions is equalized for all participants. A similar system was proposed by Congressmen Henry Waxman and Edward Markey in the American Clean Energy and Security Act of 2009. This was passed by the House of Representatives, but died in the Senate.[16] The integration of a cap-and-trade system with comprehensive tax reform would be highly problematical unless the emissions permits are auctioned to market participants to generate the same revenue as a system of environmental taxes. If the permits were distributed to existing polluters, as in the Clean Air Act Amendments of 1990 and the Waxman-Markey proposal, this revenue would not be available for deficit reduction and lowering tax rates.

B. Energy Standards. A second alternative to energy taxes is a set of energy conservation standards, such as the Corporate Average Fuel Economy (CAFE) standards imposed on automobiles. This approach shares the defect that the Joint Tax Committee has identified in tax expenditures for renewable energy sources. The incremental costs of reducing pollution vary widely among the different programs and different producers within each program. This results in an effective but very expensive approach to pollution reduction. This is the reason that most economists prefer the "market-based" approach of environmental taxes or tradable permits. The same argument applies to tax expenditures for energy conservation. Cost-ineffective regulations and tax expenditures impose an unnecessary burden on the economy. Tax expenditures are also very wasteful of taxpayer dollars, as the Joint Tax Committee's study of energy production incentives has shown.

The connection between energy production and the hidden costs of energy use is very indirect. Targeted and technology-neutral subsidies for energy production are intended to deal with a different market failure, namely, depletion of energy resources and hidden costs of energy production. These costs are also reflected in the environmental regulation of extractive industries that require remediation of production sites and mitigation of other environmental damages. While energy production policies deal with important market failures, they are not a cost-effective approach method for internalizing the hidden costs of energy use. They fail completely to reflect the substantial differences in these hidden costs associated with the different fossil fuels – coal, oil, and natural gas.

Clean Air Act Amendments of 1990: Reflections on Twenty Years of Policy Innovation," Harvard Environmental Economics Program, Cambridge, MA: Harvard Kennedy School, January. See: http://www.hks.harvard.edu/fs/rstavins/Monographs_&_Reports/SO2-Brief.pdf.

[16] An analysis of the Waxman-Markey legislation for the Environmental Protection Agency by myself and my co-authors is available on the EPA Climate Economics website: http://www.epa.gov/climatechange/EPAactivities/economics/legislativeanalyses.html#americanClan

7. Summary and Conclusions.

A. Summary. In summary, my answer to the question that motivated this hearing is that comprehensive tax reform has a very significant role to play in energy policy. A system of environmental taxes could generate as much as 1.5 percent of the GDP in federal revenue, reducing by 75 percent the gap between federal revenues as a proportion of the GDP and the long-term average. This would make a major contribution to averting the fiscal cliff facing tax policy makers at the end of this calendar year. While a cap-and-trade system could be designed to achieve the same environmental objectives, it would be a challenge to avoid diverting most of the proceeds to assure support by the taxpayers most affected by the change in energy policy.

Current tax expenditures for energy are a melange of traditional tax preferences for producers of fossil fuels, combined with trendy but very expensive tax preferences for renewable sources of energy. Tax expenditures to promote energy conservation are at cross purposes with production incentives. These tax programs are not a cost-effective way of using taxpayer dollars to deal with the market failures associated with the hidden costs of energy. These costs have been carefully summarized by the National Research Council in a Congressionally-mandated study, originally authorized by the Energy Policy Act of 2005. Fortunately, this important study has provided the information needed to design a system of energy taxes to address these market failures more directly.

B. The Case for Comprehensive Tax Reform. The case for comprehensive tax reform seems to me to be compelling. Although every major piece of tax legislation involves elements of reform, the last attempt at comprehensive reform was the Tax Reform Act of 1986. The history of this important legislation is well-known to members of this Committee and its implications are well-understood by tax reformers like Bowles and Simpson and their colleagues on the President's National Commission. Any successful program of reform will follow the path of leveling the playing field and reducing the tax rates.[17]

I would like to close with a few remarks on comprehensive tax reform. In 2001 I published a book on this topic with my former Harvard Ph.D. student, Kun-Young Yun.[18] We have recently updated this in a paper available on my Harvard website that will be published later this year.[19] We have designed an approach to comprehensive tax reform that we call Efficient Taxation of Income. This would generate additional economic growth over the coming decades that would be equivalent to a seven trillion dollar ($7,000,000,000,000) increase in our current national wealth of about $60 trillion. This is more than sufficient to restore our labor force to full employment. Combined with a

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[17] Unfortunately, the nation's fiscal situation does not offer us the luxury of a "revenue-neutral" approach to tax reform like the one employed by President Reagan and Senators Bradley and Packwood and their colleagues on the Senate Finance Committee and the House Committee on Ways and Means.

[18] Dale W. Jorgenson and Kun-Young Yun (2001), *Lifting the Burden: Tax Reform, the Cost of Capital, and U.S. Economic Growth.* Cambridge, MA, The MIT Press.

[19] Dale W. Jorgenson and Kun-Young Yun (2012), "Taxation, Efficiency, and Economic Growth, Chapter 10 in Peter B. Dixon and Dale W. Jorgenson eds., *Handbook of Computable General Equilibrium Modeling,* Amsterdam, Elsevier, 2012, forthcoming.

system of environmental taxes and restraints in spending like those proposed by Bowles and Simpson or the restraints that are now part of current law, this comprehensive tax reform would enable us to achieve a sustainable fiscal policy.

Yun and I demonstrated in earlier work that the faulty design of the Tax Reform Act of 1986 reduced the potential benefits in terms of more rapid economic growth by more than half.[20] This has imposed a substantial burden on the U.S. economy that has continued for almost twenty-six years. Our book of 2001 was entitled, *Lifting the Burden*, and I am very pleased that we have arrived at a propitious time to remedy this important oversight. This is our "moment of truth" and it is a great privilege for me to participate in this panel and assist you in your deliberations.

Table 1.–Comparison of Selected Energy Production Tax Credits

	(Column 1) Statutory credit amount	(Column 2) Credit amount in dollars per MMBtu of heat energy	(Column 3) Credit amount in dollars per MMBtu of heat energy of displaced fossil fuel feedstock**
Wind power	2.2 cents per kilowatt-hour	$6.45	$2.25
Geothermal power	2.2 cents per kilowatt-hour	$6.45	$2.25
Open-loop biomass	1.1 cents per kilowatt-hour	$3.22	$1.13
Advanced nuclear power	1.8 cents per kilowatt-hour	$5.28	$1.85
Ethanol*	45 cents per gallon	$5.92	$5.92
Biodiesel*	$1 per gallon	$8.45	$8.45

Notes:
1 kilowatt-hour = 3,412 Btus
1 gallon of ethanol = 76,000 Btus (low heating value)
1 gallon of biodiesel = 118,296 Btus (low heating value)
Displaced fossil fuel feedstock calculation assumes a fossil fuel heat rate thermal conversion factor for wind, geothermal, biomass, and nuclear power of 9,760 Btus per kilowatt-hour.
Btus per kw-hour and thermal heat rate conversion factor taken from Energy Information Agency, *Monthly Energy Review*, Table A6, p. 178 (August 2011)
Btu content of ethanol and biodiesel taken from Energy Information Agency, *Annual Energy Outlook 2007*, Table 12, p. 59 (February 2006)
* Expired December 31, 2011.
** This calculation does not account for the fossil fuels associated with the production of biofuels, nor does it account for all of the energy that is consumed indirectly in the production of electricity. Thus, for example, it does not account for the energy required to make the steel used in the construction of any wind turbines or the fossil fuels used to grow any biofuel crops.

[20] Dale W. Jorgenson and Kun-Young Yun (1990), "Tax Reform and U.S. Economic Growth," *Journal of Political Economy*, Vol. 98, No. 5, October, pp. S151-S193.

Table 2: Energy Taxes

Damages (tax rates) as a percent of consumer prices	Non-climate			Climate			Combined		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Coal	16.20%	181.68%	464.60%	12.92%	41.79%	89.22%	29.12%	223.47%	553.82%
Petroleum	0.99%	8.51%	11.25%	0.93%	3.01%	6.42%	1.92%	11.51%	17.68%
Natural Gas	0.03%	0.79%	0.82%	2.24%	7.26%	15.50%	2.27%	8.05%	16.32%

Tax revenues in billions of $(2011)	Non-climate			Climate			Combined		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Coal	$7.88	$88.40	$226.06	$6.29	$20.33	$43.41	$14.17	$108.73	$269.47
Petroleum	$8.40	$72.51	$95.94	$7.93	$25.64	$54.75	$16.33	$98.15	$150.68
Natural Gas	$0.04	$1.22	$1.26	$3.46	$11.19	$23.88	$3.50	$12.40	$25.14
Total	$16.32	$162.12	$323.25	$17.67	$57.16	$122.03	$33.99	$219.28	$445.29

Tax revenues as a percent of GDP	Non-climate			Climate			Combined		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Coal	0.052%	0.586%	1.498%	0.042%	0.135%	0.288%	0.094%	0.720%	1.785%
Petroleum	0.056%	0.480%	0.636%	0.053%	0.170%	0.363%	0.108%	0.650%	0.998%
Natural Gas	0.000%	0.008%	0.008%	0.023%	0.074%	0.158%	0.023%	0.082%	0.167%
Total	0.108%	1.074%	2.142%	0.117%	0.379%	0.808%	0.225%	1.453%	2.950%

Short Biography: Dale W. Jorgenson.[21]

I was born in the college town of Bozeman, Montana, and grew up in Helena, the state capital of Montana. I graduated from Helena High School in 1951 and received a B.A. in economics from Reed College in Portland, Oregon, in 1955. I was awarded a Ph.D. in economics at Harvard University in Cambridge, Massachusetts, in 1959. After teaching for ten years at the University of California, Berkeley, I joined the Department of Economics at Harvard in 1969 and was appointed as one of twenty University Professors in 2002. I currently reside with my wife Linda Jorgenson in Cambridge.

I first testified before the Senate Finance Committee in 1979 in opposition to what later became the Accelerated Capital Recovery System (ACRS), enacted as part of the Economic Recovery Tax Act of 1981 under President Ronald Reagan. My proposed alternative legislation was co-sponsored by Senators Max Baucus and Bill Bradley. The ACRS was replaced by the current system for capital cost recovery (MACRS) in the Tax Reform Act of 1986. I later served as a member of the Boskin Commission on the CPI, appointed by the Senate Finance Committee, which submitted its report in 1996.

I wrote a series of papers on the topic of this hearing for the U.S. Environmental Protection Agency and helped to prepare a report on this topic by the Alliance to Save Energy, *Price It Right: Energy Pricing and Fundamental Tax Reform,* published in 1998. This work is included in a volume I published with The MIT Press, *Energy, the Environment, and Economic Growth,* in 1998. I have also published two volumes on U.S. tax policy with The MIT Press in 1996 and 2001.

I have continued to focus much of my research on energy and environmental policies, most recently in work for the U.S. Environmental Protection Agency. This is available on my Harvard website and EPA's Climate Economics website.[22] A notable example is a study of the economic impact of the proposed Waxman-Markey legislation for climate policy.

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[21] A detailed biography is available on my Harvard website. See: http://www.economics.harvard.edu/faculty/jorgenson/

[22] See: http://www.epa.gov/climatechange/EPAactivities/economics.html