FEDERAL FINANCIAL SUPPORT FOR ENERGY TECHNOLOGIES: ASSESSING COSTS AND BENEFITS

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRTEENTH CONGRESS

FIRST SESSION

WEDNESDAY, MARCH 13, 2013

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CONTENTS

Wednesday, March 13, 2013

FEDERAL FINANCIAL SUPPORT FOR ENERGY TECHNOLOGIES: ASSESSING COSTS AND BENEFITS

WEDNESDAY, MARCH 13, 2013

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 3:50 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Cynthia Lummis [Chairwoman of the Subcommittee] presiding.

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RANKING MEMBER

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Subcommittee on Energy

Federal Financial Support for Energy Technologies: Assessing Costs and Benefits

Wednesday, March 13, 2013
2:00 p.m. -4:00 p.m.
2318 Rayburn House Office Building

Witnesses

Dr. Terry Dinan, Senior Analyst, Congressional Budget Office

Ms. Mary Hutzler, Distinguished Senior Fellow, Institute for Energy Research

Mr. Malcolm Woolf, Senior Vice President Policy & Government Affairs, Advanced Energy Economy

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON ENERGY

HEARING CHARTER
Federal Financial Support for Energy Technologies: Assessing Costs and Benefits

Wednesday, March 13, 2013
3:00 p.m. – 5:00 p.m.
2318 Rayburn House Office Building

PURPOSE

On Wednesday, March 13, at 3:00 p.m. in Room 2318 of the Rayburn House Office Building, the Subcommittee on Energy will hold a hearing titled, *Federal Financial Support for Energy Technologies: Assessing Costs and Benefits.* The Subcommittee will receive testimony regarding various forms of Federal financial support for the development and production of fuels and energy technologies, including tax incentives, loan guarantees, and direct spending on research, development, demonstration and commercialization activities.

WITNESS LIST

- **Dr. Terry Dinan,** Senior Analyst, Congressional Budget Office
- **Ms. Mary Hutzler,** Distinguished Senior Fellow, Institute for Energy Research
- **Mr. Malcolm Woolf**, Senior Vice President Policy & Government Affairs, Advanced Energy Economy

BACKGROUND

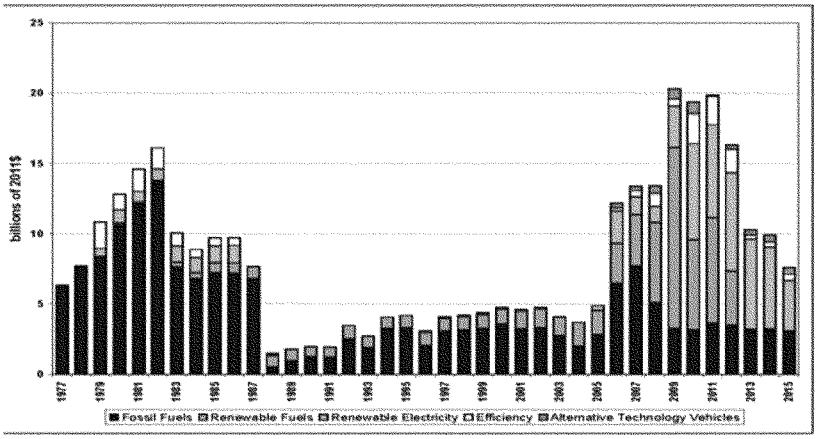
The Federal government supports the production and use of fossil, nuclear and renewable energy, while also seeking to improve energy efficiency use through various mandates, incentives and financial mechanisms. These support mechanisms include direct financial support to certain energy producers and consumers, as well as tax incentives that reduce the tax burden for producers and consumers of certain fuels and technologies.

Energy Tax Incentives and Related Trends

Tax incentives include special deductions or tax rates, tax credits, and cash grants in lieu of tax credits. Energy-related tax incentives were historically aimed at increasing fossil fuel production. Beginning in the late 1970s, this focus gradually shifted as tax incentives were added for energy efficiency and renewable energy technologies.

According to the Congressional Budget Office (CBO), energy-related tax incentives more than doubled in cost between 1977 and 1982 and then drastically fell in 1983 and again in 1988. See Figure 1. From 1988 to 2005, tax incentives gradually grew and averaged approximately $4 billion per year from 2000 to 2005. Since then, those costs rose dramatically to an average of $20 billion a year from 2009 through 2011.[1] The Joint Committee on Taxation and the Department of Treasury estimate the combined cost of reduced revenues and increased outlays amounted to approximately $21.8 billion in 2011.[2]

Figure 1. Projected Annual Cost of Energy-Related Tax Incentives
(FY1977–FY2015)



Source: CRS using data from the Joint Committee on Taxation and Office of Management and Budget.

Notes: Annual cost estimates are the sum of individual tax expenditure provisions and do not reflect possible interaction effects. The estimates also do not reflect the revenue that could be raised should specific provisions be eliminated. For all years, tax expenditure estimates are projections, not actual revenue losses. The figure does

Overall, 68 percent ($13.9 billion) of the energy-related tax incentives in 2011 were directed toward renewable energy technologies, and 10 percent ($2.1 billion) were dedicated to energy efficiency.[3] See Figure 2. The total cost of these expenditures was expected to decline in 2012 from $20.5 billion to $16.6 billion. This reduction of $4 billion is attributable to the expiration of the ethanol tax credit and Section 1603 grants in lieu of tax credits program.

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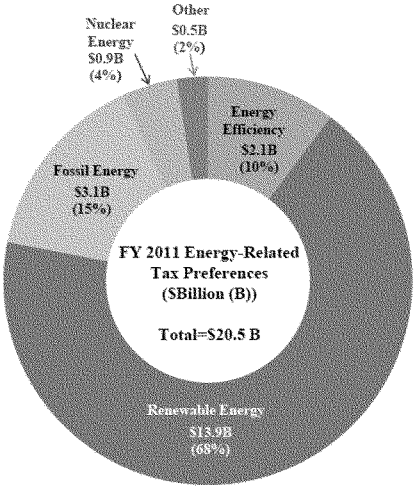
[1] Congressional Budget Office, *Federal Financial Support for the Development and Production of Fuels and Energy Technologies*, March 2012. Accessible at: http://www.cbo.gov/sites/default/files/cbofiles/attachments/03-06-FuelsandEnergy_Brief.pdf

[2] Congressional Research Service, *Energy Tax Incentives: Measuring Value Across Different Types of Energy Resources*, September 2012. Accessible at: http://www.crs.gov/Products/R/PDF/R41953.pdf. NOTE: the CRS table presented in Figure 1 does not reflect the extension of several renewable energy tax credits that were included in the American Taxpayer Relief Act of 2012.

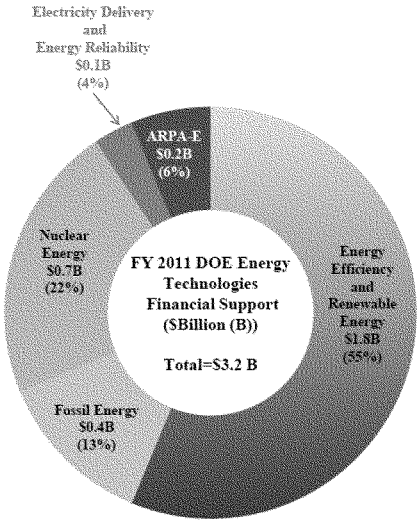
[3] CBO, *Federal Financial Support.*

FIGURE 2

FY 2011 Energy-Related Tax Incentives ($Billion (B))



FY 2011 DOE Energy Technologies Financial Support ($Billion (B))[4]



Electricity Sector Tax Incentives

Several energy-related tax incentives are targeted to encourage the production of electricity from specific energy technologies. According the Energy Information Administration, tax incentives for electricity production, excluding the Section 1603 grant program, totaled over $3.3 billion in 2010. Of this amount, the largest share ($1.2 billion) was accounted for by electricity generated by renewable energy technologies. The primary tax credits applicable to the electric sector are the Production Tax Credit (PTC), the Investment Tax Credit (ITC), and the Section 1603 grants in lieu of tax credits (Section 1603 program).

- The PTC is a per kilowatt-hour (kWh) tax credit, claimed for up to ten years, for utilities that generate electricity from qualified renewable energy resources. The PTC is a tiered credit that permits utilities to claim either 2.2 cents per kWh or 1.1 cents per kWh,

[4] DOE's FY 2011 energy technologies financial support figures include budget authority (BA) for energy efficiency and renewable energy R&D and weatherization, fossil energy R&D, nuclear energy R&D and facilities management, electricity and energy reliability, and ARPA-E programs.

depending on the technology.[5] This tax credit has expired and then been subsequently renewed or expanded by Congress on several occasions. Last January, the American Taxpayer Relief Act of 2012 extended the PTC for one additional year through the end of 2013. This one-year extension is estimated to cost $12.1 billion.[6]

- The ITC allows eligible entities to claim a tax credit equal to either 30 percent or ten percent of expenditures, depending on the electric generation technology.[7]
- The American Recovery and Reinvestment Act (ARRA) created the Section 1603 program, which offers renewable energy project developers cash payments in lieu of the PTC or ITC. The award value equals 30 percent of the project's cost.[8] The 1603 Program expired in 2012 (though the Department of Treasury continues to make payments to recipients five years after the initial award).

In 2012, the estimated costs of the PTC and ITC were $1.6 billion and $500 million, respectively. As of July 2012, the Treasury Department provided more than $13 billion to 45,000 projects cumulatively under the Section 1603 program. The majority of those awarded projects were for solar technology, but the majority of the funding was awarded to large, capital-intensive wind technology projects.[9]

Fuel Tax Incentives

The majority of tax incentives available for non-electricity fuels are provided to biofuels. In 2010, biofuels accounted for 73 percent of non-electric tax incentives, with a total cost of $6.3 billion growing to $7.5 billion in 2011. Tax incentives available to biofuels include credits for alcohol fuels, as well as excise tax credits for alcohol fuels and biodiesel. Natural gas and petroleum liquids accounted for the second-largest share of fuel tax incentives, at 20.7 percent, or $2.1 billion.[10] A table detailing spending associated with these incentives is included in Appendix II.

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[5] Qualifying technologies for 2.2 cents per kWh include wind, closed-loop biomass, geothermal, and solar (pre-2006 facilities only). Qualifying technologies for 1.1 cents per kWh include open-loop biomass, small irrigation power, municipal solid waste, qualified hydropower, and marine and hydrokinetic.

[6] The Joint Committee on Taxation, *Estimated Revenue Effects of the Revenue Provisions Contained in an Amendment in the Nature of a Substitute to H.R. 8, The "American Taxpayer Relief Act of 2012," As Passed by the Senate on January 1, 2013*, January 3, 2013.

[7] Qualifying technologies for 30% credit rate include solar electric or solar hot water property, fuel cell property, and small wind electrical generation property. Qualifying technologies for ten percent credit rate include equipment to produce energy from a geothermal deposit, equipment to use ground or ground water for heating or cooling, microturbine property (<2Mw electrical generation power plants of >26% efficiency), and combined heat and power property (simultaneous production of electrical/mechanical power and useful heat > 60% efficiency).

[8] Department of Treasury, *Overview and Status Update of the Sec. 1603 Program*, July 20, 2012. Accessible at: http://www.treasury.gov/initiatives/recovery/Documents/STATUS%20OVERVIEW.pdf

[9] Ibid.

[10] CRS, *Energy Tax Incentives*

48C Manufacturing Tax Credits

ARRA also created the Advanced Energy Manufacturing Tax Credit. This provision, commonly referred to as "48C", allows for a credit amounting to 30 percent of investment in manufacturing facilities for clean energy technologies. The 48C program is administered by the Internal Revenue Service (IRS), though DOE reviews project applications and recommends specific projects.

The credit was originally awarded to 183 domestic clean energy manufacturing facilities for a total of $2.3 billion. Last month, the IRS announced the availability of $150 million for additional 48C allocations. This funding was not fully utilized by previous awardees, and is to be reallocated on a competitive basis. The DOE will provide its recommendations on applications to the Internal Revenue Service by October.

Energy Tax Provisions in the American Taxpayer Relief Act of 2012

The American Taxpayer Relief Act of 2012 extended a number of energy tax provisions that expired at the end of 2011 or were scheduled to expire at the end of 2012. These tax provisions included incentives for alcohol fuels and biodiesel and renewable diesel, credits for alternative fuel vehicle refueling property, and credit for non-business energy property.[11]

As previously noted, the bill included a one year extension of the PTC and modified the definition of projects that qualify for the PTC.[12] Prior to this change, qualified projects had to be in service by the PTC expiration date, but the legislation modified the definition for qualifying projects to "the construction of which begins before January 1, 2014." IRS has yet to issue guidance to clarify this revised definition.

CBO estimated the cost of the energy tax provisions contained in the American Taxpayer Relief Act of 2012 to be over $18 billion.

Loan Guarantees

Section 1703 of the Energy Policy Act of 2005 (EPAct) created a loan guarantee program to support investment in a breadth of energy technology areas and innovative clean-energy facilities. The 2009 ARRA legislation added what is known as the Section 1705 loan program to support loans for renewable energy technologies, electric power transmission, and biofuel projects. The authority for the Section 1705 loan program expired on September 30, 2011. Over the life of this program, DOE guaranteed loans to 26 projects amounting to $16 billion in financial capital.[13]

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[11] Congressional Research Service, *An Overview of the Tax Provisions in the American Taxpayer Relief Act of 2012*, February 4, 2013. Accessible at: http://www.crs.gov/Products/R/PDF/R42894.pdf

[12] P.L. 112-240, Sect 407(b)

[13] Department of Energy, *Loan Programs Office Projects.* Accessible at: https://lpo.energy.gov/?page_id=45

The primary difference between the 1703 and 1705 versions of the loan guarantee program was that projects under Section 1705 were not required to pay the "credit subsidy cost" of a loan guarantee. The credit subsidy cost is an up-front payment that addresses the risk to the Federal government in case of default on a loan. Credit subsidy costs for the 1705 program were paid for by funds appropriated in ARRA.

In April 2011, the Department of Defense and Full-Year Continuing Appropriations Act provided $170 million in appropriations for new loan commitments under the Section 1703 program. DOE has yet to award this funding. However, in April 2012, Acting Loan Program Office Director David Frantz sent a letter to Congress indicating DOE's intention to award this funding soon, stating:

> "The exact number of projects and the total dollar value of the loan guarantees in this §1703 pipeline will depend on the government's assessment of the risk level of the projects selected. The Department expects to begin issuing conditional commitments over the next several months after completing a rigorous internal and external review of each application. This evaluation will build on the extensive work that had already begun last year prior to the applications being put on hold."[14]

Direct Spending

DOE's direct spending activities primarily consist of research, development, demonstration and commercial application of energy technology programs in four general technology areas: energy efficiency and renewable energy; electricity delivery and energy reliability; nuclear energy; and fossil energy. Additionally, the Advanced Research Projects Agency – Energy (ARPA-E) funds research and development projects across all energy technology areas. In Fiscal Year (FY) 2012, DOE spent approximately $3.3 billion on applied energy research programs (Figure 2).[15]

ADDITIONAL READING

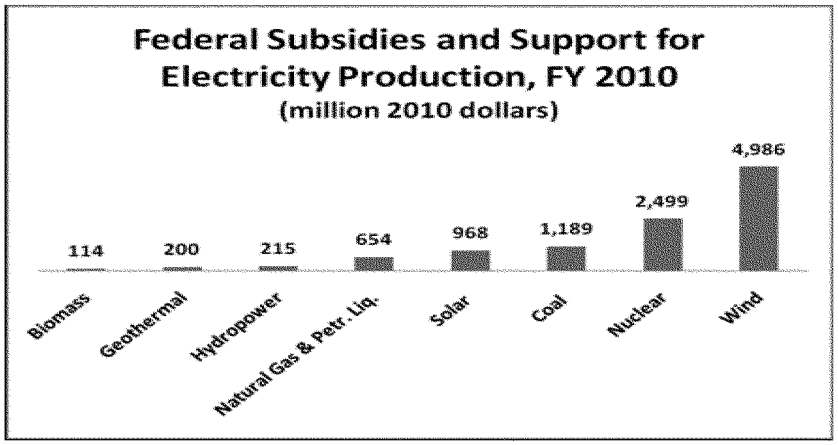
For additional information and background on Federal financial support for energy production and technologies see:

- Congressional Budget Office, *Federal Financial Support for the Development and Production of Fuels and Energy Technology*, March 2012.
- Congressional Research Service, *Energy Tax Incentives: Measuring Value Across Different Types of Energy Resources*, September 18, 2012.

[14] Department of Energy, *Update on the 1703 Loan Program*, April 5, 2012. Accessible at: http://energy.gov/articles/update-1703-loan-program
[15] CBO *Federal Financial Support*

- Energy Information Administration, *Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2010*, July 2011.
- Congressional Research Service, *An Overview of the Tax Provisions in the American Taxpayer Relief Act of 2012*, February 4, 2013.

Appendix 1 – CRS Graph on Technology Specific Subsidies



CRS: The value of federal tax support for the energy sector was estimated to be $19.1 billion in 2010. Of this, roughly one-third ($6.3 billion) was for tax incentives that support renewable fuels. Another $6.7 billion can be attributed to tax-related incentives supporting various renewable energy technologies (e.g., wind and solar). Targeted tax incentives supporting fossil energy resources totaled $2.4 billion.

Appendix 2 – CRS Summary Table of Energy Tax Provisions

Table 2. Estimated Revenue Cost of Energy Tax Provisions: Fiscal Years 2010 through 2012

($ billions)

Provision	2010	2011	2012
Fossil Fuels			
Expensing of Exploration and Development Costs for Oil and Gas	0.7	0.8	0.8
Percentage Depletion for Oil and Gas	0.5	0.9	0.9
Amortization of Geological and Geophysical Costs for Oil and Gas Exploration	0.1	0.1	0.1
15-year Depreciation for Natural Gas Distribution Lines	0.1	0.1	0.1
Election to Expense 50% of Qualified Refinery Costs	0.7	0.8	0.7
Amortization of Air Pollution Control Facilities	0.1	0.2	0.2
Credits for Investments in Clean Coal Facilities	0.2	0.2	0.2
Excise Tax Credits for Alternative Fuel Mixtures	n.a.	0.2	0.2
Subtotal, Fossil Fuels	*2.4*	3.3	3.2
Renewables			
Production Tax Credit (PTC)	1.4	1.4	1.6
Investment Tax Credit (ITC)	(i)	0.5	0.5
Accelerated Depreciation for Renewable Energy Property	0.3	0.3	0.3
Section 1603 Grants in Lieu of Tax Credits[a]	4.2	3.5	4.1
Credit for Clean Renewable Energy Bonds (CREBs)	0.1	(i)	(i)
Residential Energy Efficient Property Credit	0.2	0.2	0.2
Credit for Investment in Advanced Energy Property	0.5	0.7	0.4
Subtotal, Renewables	*6.7*	*6.6*	*7.1*
Renewable Fuels			
Credits for Alcohol Fuels	0.1	0.2	0.1
Excise Tax Credits for Alcohol Fuels[a]	5.7	6.5	3.6
Excise Tax Credits for Biodiesel[b]	0.5	0.8	0.2
Subtotal, Renewable Fuels	*6.3*	*7.5*	*3.9*
Efficiency & Conservation			
Energy Efficiency Improvements to Existing Homes	1.7	1.5	1.3
Credit for Production of Energy Efficient Appliances	0.2	0.2	0.1
Energy Efficient Commercial Building Deduction	0.2	0.2	0.2
10-year Depreciation for Smart Electric Distribution Property	(i)	0.1	0.1
Subtotal, Efficiency & Conservation	*2.1*	*2.0*	*1.7*
Alternative Technology Vehicles			
Credits for Alternative Technology Vehicles	0.8	(i)	(i)
Credit for Plug-In Electric Vehicles	n.a.	0.1	0.3
Subtotal, Alternative Technology Vehicles	*0.8*	*0.1*	*0.3*
Other			
Percentage Depletion for Other Fuels	0.2	0.2	0.2
15-year Depreciation for Electric Transmission Property	0.1	0.1	0.2
Exceptions for Publicly Traded Partnerships with Qualified Income from Energy-Related Activities	0.5	0.2	0.2
Special Rule to Implement Electric Transmission Restructuring	(i)	1.8	-0.2
Subtotal, Other	*0.8*	*2.3*	*0.4*
Total	**19.1**	**21.8**	**16.6**

Sources: Joint Committee on Taxation and the Department of the Treasury.

Appendix 3 – CRS Table of Energy Tax Incentives and Production

Table 3. Comparing Energy Production and Energy Tax Incentives: Fossil Fuels and Renewables

(2010)

	Production		Tax Incentives	
	Quadrillion Btu	% of Total	Billions of Dollars	% of Total
Fossil Fuels	58.5	78.0%	$2.4	12.6%
Renewables[a]	8.1	10.7%	$13.0	68.1%

	Production		Tax Incentives	
	Quadrillion Btu	% of Total	Billions of Dollars	% of Total
Renewables (excluding hydro-electric)	*5.6*	*7.4%*	*$13.0*[b]	*68.1%*[b]
Renewables (excluding biofuels and related tax incentives)	*6.2*	*8.3%*	*$6.7*	*35.1%*
Renewables (excluding hydro-electric and biofuels and related tax incentives)	*3.7*	*4.9%*	*$6.7*[b]	*35.1%*[b]

Source: Calculated using data presented in Table 1 and Table 2 above.

a. Renewables tax incentives include targeted tax incentives designed to support renewable electricity and renewable fuels.

b. The value of total tax incentives for renewables excluding hydro-electric power is less than the total value of tax incentives when those available for hydro-power are included. However, the difference is small. JCT estimates that in 2010, the tax expenditures for qualified hydropower under the PTC are less than $50 million. During 2010, two awards totaling $88,000 were paid to hydropower facilities under the Section 1603 grant program. Hydropower has also received less in CREB financing than was awarded to solar and wind technologies. During 2010, the tax expenditure for CREBs was an estimated $0.1 billion across all technologies.

Chairwoman LUMMIS. My name is Cynthia Lummis, and I am the Chairman of the Committee. And I would like to welcome our Ranking Member and fellow Members of this Committee. This is the Energy Subcommittee hearing on "Federal Financial Support for Energy Technologies." And the meeting will come to order.

In front of you are packets containing the written testimony, biographies, and truth-in-testimony disclosures for today's panel. And now, I recognize myself for a five-minute opening statement.

We are delighted to have you here, and thank you very much to our witnesses for joining us.

Building on our broad examination of America's energy outlook a few weeks ago, this is the second of our hearings today. We are focusing on the amount and effectiveness of various forms of financial support for energy technologies. I hope these overview hearings will prove informative and valuable, because we will be pivoting next to specific legislation activities. So it will happen within our research and development jurisdiction, including some oversight activities as well.

The topic of today's hearing is timely, as federal spending and budget prioritization are receiving a lot of attention today over in the Budget Committee—they are marking up the budget—and because of the implementation of the recent sequester.

A central component of the House Republican budget is to open more federal lands to energy development. Now, I advocate for this, because it will accelerate our path to energy independence. It will create jobs. It will contribute greatly to deficit reduction and open spaces for future generations.

Now, we are going to hear today from the Congressional Budget Office. Federal energy tax subsidies will total more than 16 billion in 2013, up from just five billion in 2005. This increase reflects President Obama's interest in rapid deployment of green energy technologies.

January's fiscal cliff deal is a prime example. The White House was purportedly absolutely insistent that the package extend and expand the Production Tax Credit for renewable energy. This extension will cost taxpayers at least $12 billion this year. And then in the meantime, we hear some of our constituents, and certainly the Administration, are very concerned about cuts to areas such as national parks, science, oil and gas permitting, and even White House tours. I believe that it is worth looking at the Production Tax Credit as an example of where we might find some efficiencies.

Another example is the Alternative Vehicle Tax Credit, which provides $7,500 towards the purchase of alternative vehicles such as the $40,000 Chevy Volt and the $100,000 Fisker Karma. GM reports the average Volt owner earns $170,000 a year. And the Karma is even more exclusive. Really, only the rich and famous can afford a Karma. And as was recently pointed out, electrical vehicles do not reduce carbon emissions significantly, so it really does call into question the entire justification for spending this money in the first place.

Whereas, right now, all over the country where there are natural gas vehicles, they are running on $.99 per gallon of oil equivalent fuel. Now, can you imagine what that would do for the cost of living for single moms and hard-working taxpayers? So I really think

that we need to look at some of the other technologies going on out there.

Government should be working to ensure that Americans have access to abundant, affordable, reliable energy and target taxpayer resources to fundamental research that could one day enable these technologies to compete without expensive subsidies or mandates. Doing so would not only help bring energy independence and grow our economy, but it would bring revenue to the Treasury.

Again, I want to thank our witnesses for joining us today. And I now recognize Ranking Member Swalwell for an opening statement.

[The prepared statement of Mrs. Lummis follows:]

PREPARED STATEMENT OF SUBCOMMITTEE CHAIRMAN CYNTHIA M. LUMMIS

Good afternoon and welcome to today's Energy Subcommittee hearing on "Federal Financial Support for Energy Technologies: Assessing the Costs and Benefits."

Building on our broad examination of "America's Energy Outlook" a few weeks ago, this is the second stage-setting hearing. We will focus today on the amount and effectiveness of various forms of financial support for energy technologies. I hope these overview hearing will prove informative and valuable as we pivot to specific legislative activities within our research- and-development-focused jurisdiction.

The topic of today's hearing is particularly timely, as federal spending and budget prioritization receive extra attention following the recent implementation of the budget sequester and release of House Republicans' FY 14 budget.

A central component of the House Republican budget is to open more federal lands to energy development. I advocate for this priority because it will accelerate our path to energy independence, create jobs, contribute greatly to deficit reduction, and can be done while conserving our public lands and open space for future generations.

As we will hear today from the Congressional Budget Office, federal energy tax subsidies will total more than $16 billion in 2013, up from just $5 billion in 2005. This increase reflects President Obama's interest in rapid deployment of green energy technologies.

January's "fiscal cliff" deal is a prime example. The White House was reportedly "absolutely insistent" that the package extend and expand the Production Tax Credit (PTC) for renewable energy. This one-year extension will cost taxpayers at least $12 billion.

Meanwhile, the Administration is complaining loudly about cuts to areas such as national parks, science, oil and gas permitting, and even White House tours.

Another example is the alternative vehicle tax credit, which provides $7,500 toward the purchase of alternative vehicles such as the $40,000 Chevy Volt and $100,000 Fisker Karma. GM reports the average Volt owner earns $170,000 per year. The Karma is even more exclusive; only the rich or famous can afford them. As was pointed out by the *Journal of Industrial Ecology*, electric vehicles do not reduce carbon emissions significantly, calling into question the entire justification for spending this money in the first place.

Right now, natural gas vehicles can run on a $.99 per gallon of oil-equivalent fuel. Now that price will transform the cost of living for single moms and hard-working taxpayers.

Government should work to ensure that Americans have access to abundant, affordable, reliable energy, and target taxpayer resources to fundamental research that could one day enable these technologies to compete without expensive subsidies or mandates. Doing so would not only help bring energy independence and grow our economy, but it would bring revenue to the Treasury.

I thank our witnesses for joining us today and look forward to a productive discussion.

I now recognize Ranking Member Swalwell for an opening statement.

Mr. SWALWELL. Thank you, Chairman Lummis, for holding this hearing today. I appreciate the opportunity to discuss the range of instruments that government can utilize to affect change or maintain the status quo in the energy marketplace.

My interest in the subject lies firmly in the category of effecting change, of working with my colleagues in Congress to lead the innovation agenda, and to promote clean energy policies that can create made-in-America jobs. For reasons that range from establishing U.S. leadership in the booming global clean energy market to protecting consumers and domestic industries from energy price shocks to protecting our children from the shock of a rapidly changing climate, the status quo in energy is simply unsustainable.

I understand that energy legislation is in the works here, as the Chairman referenced. I hope that we on the Science Committee can work together throughout Congress to craft policies that are both forward-leaning and pragmatic and that we can take lessons learned from past experiences to right-size the role of government in spurring innovation in our energy systems.

To do that, we must first acknowledge that the energy marketplace is not a free market. For one, as many of my Republican colleagues, I am sure, would likely agree, it is heavily regulated at both the state and national level. It is also heavily biased towards favoring incumbent technologies over investments in new or advanced systems that can deliver cleaner, smarter, more sustainable energy to consumers. Furthermore, the pathway from idea to scale-up is fraught with technical and financial risks that can derail even the most resourceful developers.

The taxpayers want lower-cost, reliable energy with as few of the harmful environmental effects and impacts as possible. And they increasingly demand more control and more choices in the fuels and technologies they use. Until our policies start to address the numerous market failures that new concepts face and reevaluate them on a regular basis, we will not lay the groundwork for a fully competitive energy marketplace in the United States.

These difficulties are only exacerbated when we in Washington politicize energy in a manner that does not reflect either market realities or society's good. As we see the tired arguments over industrial policy reemerge, we would benefit from looking at the lengths our global competitors are willing to go to capture market share, as well as the past efforts we have made in picking the energy winners we have today. But bickering over who gets to pick winners and losers simply misses the point. And to quote the Ranking Member of this Committee, Ranking Member Johnson, from a recent op-ed, "It is a waste of time to argue over the rules of the game that our competitors are not even playing."

Meanwhile, draconian cuts to the Nation's innovation enterprise stand to cripple us even further. Aside from the obvious impact that sequestration will have on personnel and activities at agencies such as the Department of Energy, subjecting stakeholders to such dramatic fluctuations, depriving the market of certainty is just a bad way to do business. We have a long history in this country of leveraging the power of public-private partnerships to achieve ends that neither governments nor industry can do on its own. When you take one side of that away, you pull the rug out from other big initiatives that would benefit us all.

The people that drive innovation in our economy from the national laboratories—and we have two of them in my Congressional District—to university students and professors and researchers

who push the frontiers of knowledge to the venture capitalists who put their money on new concepts to the industrial firms that scale-up manufacturing and infrastructure all know that government has always played a critical role in making the U.S. the most dominant economy in the world. In fact, our oil, gas, coal, and nuclear sectors are direct results of that.

It is time that we get serious about picking more winners and doing whatever it takes from basic and applied research all the way to innovative financing and tax instruments to ensure that the United States has cleaner, more sustainable, and more energy that is affordable for future generations to come.

With that, I yield back the balance of my time.

[The prepared statement of Mr. Swalwell follows:]

PREPARED STATEMENT OF RANKING MEMBER ERIC SWALWELL

Thank you, Chairman Lummis, for holding this hearing today. I appreciate the opportunity to discuss the range of instruments that government can utilize to affect change or maintain the status quo in the energy marketplace.

My interest in the subject lies firmly in the category of effecting change. For reasons that range from establishing U.S. leadership in the booming global clean energy market to protecting consumers and domestic industries from energy price shocks to protecting our children from the shock of a rapidly changing climate, the status quo in energy is simply unsustainable.

I understand that energy legislation is in the works here. I hope that we on the Science Committee can work together throughout this Congress to craft policies that are both forward-leaning and pragmatic, and that we can take lessons learned from past experience to right-size the role of government in spurring innovation in our energy systems.

To do that, we must first acknowledge that the energy marketplace is not a "free" market. For one, as my Republican friends will likely agree, it is heavily regulated at both the state and national levels. It is also heavily biased towards favoring incumbent technologies over investments in new, more advanced systems that can deliver cleaner, smarter, more sustainable energy to consumers. Furthermore, the pathway from idea to scale-up is fraught with technical and financial risks that can derail even the most resourceful developers.

The taxpayers want lower-cost, reliable energy with few, if any, harmful environmental impacts, and they increasingly demand more control and more choices in the fuels and technologies they use. Until our policies start to address the numerous market failures that new concepts face, and reevaluate them on a regular basis, we will not lay the groundwork for a truly competitive energy marketplace in the U.S.

These difficulties are only exacerbated when we in Washington politicize energy in a manner that does not reflect either market realities or societal good. As we see the tired arguments over industrial policy reemerge, we would benefit from looking at the lengths our global competitors are willing to go to to capture market share, as well as the past efforts we have made in picking the energy "winners" we have today. But bickering over who gets to pick winners and losers simply misses the point. To quote Ranking Member Johnson from a recent op-ed, "It is a waste of time to argue over the rules of a game that our competitors aren't even playing."

Meanwhile, draconian cuts to the Nation's innovation enterprise stand to cripple us even more. Aside from the obvious impact that sequestration will have on personnel and activities at agencies such as the Department of Energy, subjecting stakeholders to such dramatic fluctuations is just a bad way to do business. We have a long history in this country of leveraging the power of public-private partnerships to achieve ends that neither government nor industry can do on its own. When you take one side of that away, you pull the rug out from under big initiatives that benefit all of us.

The people that drive innovation in our economy—from the National Lab and university scientists who push the frontiers of knowledge to the venture capitalists who put their money on new concepts to the industrial firms that scale up manufacturing and infrastructure—all know that government has always played a critical role in making the U.S. the most dominant economy in the world. In fact, our oil, gas, coal and nuclear sectors are a direct result of that. It is time that we get serious about picking more winners and doing whatever it takes, from basic and applied

research all the way to innovative financing and tax instruments, to ensure that the U.S. has cleaner, more sustainable, and more affordable energy for generations to come.

With that, I yield back the balance of my time.

Chairwoman LUMMIS. Thank you, Mr. Swalwell. Now, if there are any Members who wish to submit additional opening statements, your statements will be added to the record at this point. Anyone? Okay. Thank you very much.

I would like to recognize the presence of the Full Committee Chairman, Lamar Smith, at our hearing. And at this time, I would like to introduce our witnesses.

Our first witness is Dr. Terry Dinan, Senior Analyst at CBO. She has a Ph.D. in economics from Ohio State University. Welcome.

Our second witness today is Ms. Mary Hutzler, Distinguished Senior Fellow at the Institute for Energy Research. She received her M.A. in applied mathematics from the University of Maryland. Welcome, Ms. Hutzler.

And our final witness today is Mr. Malcolm Woolf, Senior Vice President and Government Affairs at the Advanced Energy Economy. And Mr. Woolf has a law degree and an MPA from University of Virginia. Welcome all.

The witnesses' spoken testimony is limited to five minutes each, after which Members of the Committee will have five minutes each to ask questions.

I now recognize Dr. Dinan for five minutes to present her testimony.

STATEMENT OF DR. TERRY DINAN, SENIOR ANALYST, CONGRESSIONAL BUDGET OFFICE

Dr. DINAN. Chairman Lummis, Congressman Swalwell, and Members of the Subcommittee, thank you for the invitation to testify on the financial support that the Federal Government provides for the development——

Chairwoman LUMMIS. Dr. Dinan, could you pull the mike just a little closer to your face——

Dr. DINAN. Oh, sure.

Chairwoman LUMMIS [continuing]. And make sure that red light is on as well.

Dr. DINAN. The light is on.

Chairwoman LUMMIS. Okay.

Dr. DINAN. Does that work now?

Chairwoman LUMMIS. Thank you.

Dr. DINAN. Okay. Thank you for the invitation to testify on the financial support that the Federal Government provides for the development and production of fuels and energy technologies. That support totals almost 20 billion in the current fiscal year. Tax preferences account for about 5/6 of that amount. Spending programs administered by the Department of Energy account for the remaining share.

I would like to begin by discussing tax preferences, which primarily consist of special tax credits or rules that reduce the amount of taxes that people or businesses pay. As shown in Figure 1, which is now on display, for most years until 2005, the largest

share of that support went to domestic producers of oil and gas. Beginning in 2006, the cost of energy-related tax preferences grew substantially. Moreover, an increasing share of the cost was aimed at encouraging energy efficiency and the use of energy produced from renewable sources, which generally cause less environmental damage than producing energy from fossil fuels.

In 2013, as shown in Figure 2, provisions aimed at energy efficiency and renewable energy account for about 3/4 of the estimated budgetary cost of the Federal energy-related tax preferences. That mix reflects changes to the tax system made by the American Taxpayer Relief Act of 2012 which extended until the end of this calendar year for major preferences aimed at increasing energy efficiency and promoting the use of renewable sources of energy.

Under current law, the mix of energy tax preferences will look quite different in the future. That is because most of the support for energy efficiency and renewable energy comes from provisions that have already expired or are scheduled to expire at the end of this year. In contrast, most of the support for fossil fuels and nuclear power comes from provisions that are permanent.

Next, I would like to turn to the Department of Energy. DOE supports energy technologies by making investments in them and by subsidizing or guaranteeing loans. As depicted in Figure 3, the amount of support has varied over time but has generally declined in recent years. Measured in 2013 dollars, DOE's support for energy technologies totaled $10.5 billion in 1980 and is $3.4 billion in 2013. The notable exception to the trend in DOE's support is the spike in 2009, which reflects the increase in funding provided by the economic stimulus legislation.

In 2013, which is depicted in Figure 4, more than half of DOE's support for energy technologies is directed towards energy efficiency and renewable energy. Twenty-two percent is for nuclear energy, and 15 percent is for fossil fuels. Most of the spending in each of those categories goes towards applied research and development. The Congress has not appropriated funds for subsidy costs of DOE's loan programs since 2011. Since appropriations were provided in 2009, DOE's net obligations for subsidy costs have totaled about $4 billion. That amount supported direct loans of about $9 billion for advanced automotive technology projects and loan guarantees of about $16 billion for renewable energy projects.

There are two main economic rationales for the government's involvement in energy markets. First, without government intervention, households and businesses do not have a financial incentive to take into account the environmental damage or other costs to the Nation associated with their choices about energy production and consumption. The most direct and cost-effective method for addressing that problem would be to levy a tax on energy sources that reflects the environmental costs caused by their production and use. Subsidies such as tax preferences for favored technologies can accomplish some of the same goals but in a less cost-effective way.

Second, unless the government intervenes, the amount of certain types of research and development is likely to be inefficiently low from society's perspective. Such underinvestment is particularly likely in the early stages of developing a technology. Research at

that stage can create fundamental knowledge that can lead to significant benefits for society as a whole, but not necessarily for the firms that funded the research. Thus, government funding can be beneficial.

By contrast, DOE's funding of energy technology demonstration projects at later stages in the development process has been far less cost effective, and DOE has been criticized for its management of such projects.

Thank you for the opportunity to testify. I am happy to answer any of your questions.

[The prepared statement of Dr. Dinan follows:]

Congressional Budget Office

Testimony

Federal Financial Support for Fuels and Energy Technologies

Terry M. Dinan
Senior Advisor

Before the
Subcommittee on Energy
Committee on Science, Space, and Technology
U.S. House of Representatives

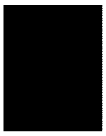
March 13, 2013

This document is embargoed until it is delivered at 3:00 p.m. (EDT) on Wednesday, March 13, 2013. The contents may not be published, transmitted, or otherwise communicated by any print, broadcast, or electronic media before that time.

Notes

Numbers in the text, figures, and tables may not add up to totals because of rounding.

All dollar amounts are in current dollars unless otherwise specified.



Contents

Chairman Lummis, Congressman Swalwell, and Members of the Subcommittee, thank you for the invitation to testify on federal financial support for the development and production of fuels and energy technologies. My testimony updates a Congressional Budget Office report from 2012 on the same topic.[1]

Summary

The federal government has provided various types of financial support for the development and production of fuels and energy technologies in recent decades. That support—which has taken the form of tax preferences (special provisions of tax law that reduce tax liabilities for certain activities, entities, or groups of people) and spending programs administered by the Department of Energy (DOE)—totals an estimated $19.8 billion in fiscal year 2013. (Unless otherwise indicated, all years discussed in this testimony are fiscal years, and all dollars are expressed in current terms.) That amount includes $16.4 billion in tax preferences and $3.4 billion in funding for DOE.

Tax Preferences Provide Much of the Federal Support for Fuels and Energy Technologies

Tax preferences for fuels and energy technologies were first established in 1916. For most years until 2005, the largest share of the support they provided went to domestic producers of oil and natural gas. Beginning in 2006, the cost of energy-related tax preferences grew substantially, and an increasing share of those costs was aimed at encouraging energy efficiency and energy produced from renewable sources, such as wind and the sun, which generally cause less environmental damage than does producing and consuming fossil fuels. Provisions aimed at increasing energy efficiency and the use of renewable sources of energy account for 74 percent of the estimated budgetary cost of federal energy-related tax preferences in fiscal year 2013. That mix reflects changes to the tax system made by the American Taxpayer Relief Act of 2012, which extended until December 31, 2013, four major provisions aimed at increasing energy efficiency and the use of renewable sources of energy. Those four provisions account for $6.8 billion of the cost in 2013.

Under current law, the mix of energy tax preferences will look quite different in the future. Most of the support for energy efficiency and renewable energy comes from provisions that have already expired or are scheduled to expire at the end of 2013. In contrast, most of the support for fossil fuels and nuclear power comes from provisions that are permanent.

Federal Support Is Also Provided in the Form of Direct Investments, Loans, and Loan Guarantees

The Department of Energy, which was established in 1977, also supports energy technologies by making direct investments (primarily for research and development) and by providing loans or loan guarantees. That support has varied over time, but, with the exception of the substantial funding provided in the 2009 economic stimulus legislation (the American Recovery and Reinvestment Act of 2009, or ARRA), it has generally declined—from $10.6 billion (in 2013 dollars) in 1980 to $3.4 billion in both 2012 and 2013. About half of that support is directed toward energy efficiency and renewable energy in 2013.

DOE received roughly $10 billion in funding for its subsidized credit programs in 2009 but has received only limited additional subsidy funding for those programs since then: $170 million in 2011 and no new subsidy funding in 2010, 2012, or 2013. Between 2009 and 2012, DOE provided an estimated $4 billion in subsidies for about $25 billion in loans and loan guarantees, primarily to generators of solar power, manufacturers of solar equipment, and producers of advanced vehicles.

The Government's Involvement in Energy Markets Can Sometimes Lead to a More Efficient Use of Resources

Without government intervention, households and businesses do not have a financial incentive to take into account the environmental damage or other costs to the nation associated with their choices about energy production and consumption. The most direct and cost-effective method for addressing that problem would be to levy a tax on energy sources that reflects the environmental costs associated with their production and use. Subsidies (such as tax preferences) for favored technologies can accomplish some of the same goals but in a less cost-effective way.

Also, unless the government intervenes, the amount of research and development (R&D) that the private sector undertakes is likely to be inefficiently low from society's perspective because firms cannot easily capture the "spillover benefits" that result from it, particularly in the early stages of developing a technology. Such research can create fundamental knowledge that can lead to significant

1. See Congressional Budget Office, *Federal Financial Support for the Development and Production of Fuels and Energy Technologies* (March 2012), www.cbo.gov/publication/43032.

benefits for society as a whole but not necessarily for the firms that paid for that research; thus government funding can be beneficial. By contrast, DOE's funding of energy technology demonstration projects at later stages in the development process has been far less cost-effective. Moreover, the Government Accountability Office, among others, has criticized DOE's management of such projects.

Tax Preferences

The federal government supports the production and use of fossil fuels, nuclear power, and renewable energy and encourages increased energy efficiency through provisions of law that reduce the amount of taxes paid by producers and consumers of energy from those fuels or technologies. Those tax preferences include special deductions, special tax rates, tax credits, and grants in lieu of tax credits. In 2013, the combined cost of reduced revenues and increased outlays from those tax preferences amounts to an estimated $16.4 billion according to the staff of the Joint Committee on Taxation. (See Table 1 on page 4, which reports preferences that are estimated to cost at least $50 million.)

The $16.4 billion does not include all tax provisions that benefit producers or consumers of fossil fuels, nuclear power, renewable energy, and energy efficiency. It excludes tax provisions that benefit the energy industry generally (such as the preference that allows firms to defer taxes on the gains from sales of electric transmission assets as a means of accelerating the restructuring of the electric transmission system) rather than target a particular fuel or energy-generating technology. Tax preferences designed to promote new fuels and energy technologies account for a small percentage of the cost of all federal tax preferences, which total hundreds of billions of dollars per year.[2]

Historical Trends

From 1916 to the 1970s, federal energy-related tax policy focused almost exclusively on increasing the production of domestic oil and natural gas; there were no tax incentives for promoting renewable energy or increasing energy efficiency.[3] In the 1970s, lawmakers began adding tax preferences for new sources of fossil fuel, alternatives to fossil fuel, and energy efficiency. Disruptions in the supply of oil in the 1970s heightened interest in encouraging the production of alternative transportation fuels, such as ethanol and "unconventional fuels" (for example, oil produced from shale and tar sands, or synthetic fuel produced from coal). Furthermore, growing awareness of environmental damage caused by producing energy from fossil fuels—such as the harmful effects of the carbon dioxide (CO_2) emissions from burning those fuels—led to tax preferences for improvements in energy efficiency and for the production of electricity from renewable sources.

Nevertheless, tax preferences for fossil fuels continued to make up the bulk of all energy-related tax incentives through the mid-2000s, accounting for more than two-thirds of the total cost in most years. The Energy Policy Act of 2005 changed the focus of energy-related tax policy—adding a number of provisions aimed at increasing energy efficiency and the use of alternative motor vehicles, such as fuel-cell and hybrid vehicles—and substantially increased the number of energy-related tax preferences and their total cost. By 2008, fossil fuels accounted for only 33 percent of the total cost of energy-related tax incentives. The Emergency Economic Stabilization Act of 2008 expanded and extended provisions related to energy efficiency and renewable energy. ARRA further expanded tax preferences for energy efficiency, renewable energy, and alternative vehicles. In addition, it created the Section 1603 grant program, which allowed producers of renewable energy to collect one-time cash payments in lieu of tax credits for current investment or future production.[4]

The value of tax preferences related to energy and the composition of that financial support have changed over

2. For a recent estimate of such costs, see Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2012–2017*, JCS-1-13 (February 1, 2013), www.jct.gov/publications.html?func=startdown&id=4503.

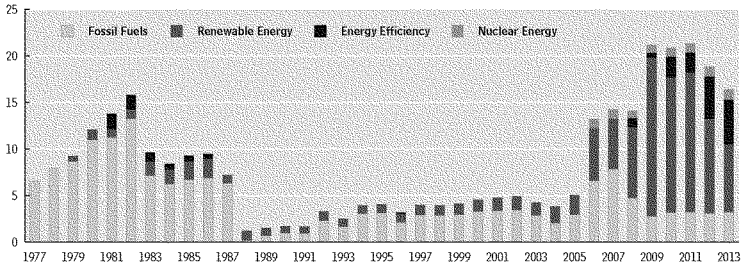
3. This discussion of historical trends draws largely from Molly F. Sherlock, *Energy Tax Policy: Historical Perspectives on and Current Status of Energy Tax Expenditures*, Report for Congress R41227 (Congressional Research Service, May 2, 2011).

4. Before Section 1603 grants were available, qualifying renewable-energy projects were federally supported primarily through production or investment tax credits. The Section 1603 grant program allowed companies to receive up-front cash grants in lieu of those tax credits, which, in many cases, the companies would be able to use only in future years in which they had sufficient tax liability.

Figure 1.

Cost of Energy-Related Tax Preferences, by Type of Fuel or Technology

(Billions of 2013 dollars)



Source: Congressional Budget Office based on data from Molly F. Sherlock, *Energy Tax Policy: Historical Perspectives on and Current Status of Energy Tax Expenditures*, Report for Congress R41227 (Congressional Research Service, May 2, 2011), p. 26; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2012–2017*, JCS-1-13 (February 1, 2013), pp. 33–35, www.jct.gov/publications.html?func=startdown&id=4503; and the Office of Management and Budget.

Note: The estimates of costs resulting from individual tax preferences do not account for any potential interactions between preferences and do not include tax provisions estimated to cost less than $50 million. Nor do they reflect the budgetary effects of eliminating those preferences and of taxpayers' adjusting their activities in response to those changes.

time. Those changes stem from a combination of factors, including changes in the number of energy-related tax preferences; changes in the prices of oil and natural gas, which affect investment in those industries; and increases or decreases in overall tax rates, which make some existing tax preferences more or less valuable. In some cases, an existing tax credit was applied for a new purpose. For example, an income tax credit for alternative fuel mixtures was initially intended as an incentive for firms to produce liquid motor fuels from biomass (organic materials used to produce energy). In 2009, however, pulp and paper producers claimed the credit for blending "black liquor"—a by-product of the pulping process that is used to make paper—with liquid petroleum-based fuels to power their paper-making operations. That use greatly expanded the cost of the credit, which was allowed to expire at the end of 2009. The Internal Revenue Service subsequently ruled that black liquor would qualify for a different credit—the cellulosic biofuel producer tax credit; however, lawmakers later amended the law to prevent that unintended use.

Measured in 2013 dollars, the cost of energy-related tax preferences more than doubled between 1977 and 1982 and then fell dramatically between 1982 and 1988, in part because of declines in tax rates and fuel prices (see Figure 1). The cost of energy-related tax preferences grew gradually between 1988 and 2005 and averaged about $5 billion a year (in 2013 dollars) from 2000 to 2005. Tax support has grown substantially since 2005, driven, in part, by new provisions in the Energy Tax Policy Act of 2005. The cost of tax preferences reached their peak from 2009 through 2011, exceeding $20 billion in each of those years, and has declined in both 2012 and 2013. That decline is due, in part, to the expiration of certain provisions, such as an excise tax credit for alcohol fuel (which expired on December 31, 2011).

Financial Support in 2013

The tax preferences that explicitly target energy use and production take three forms: preferences in the income tax system, such as special deductions, special tax rates, and credits; an excise tax credit; and Section 1603 grants (in lieu of future tax credits). In 2013, those preferences are estimated to provide financial support as follows:

Table 1.

Energy-Related Tax Preferences in Fiscal Year 2013

Primary Target of Support	Tax Preference	Total Cost in 2013 (Billions of dollars)	Expiration Date
	Energy-Related Tax Preferences Affecting Income Taxes		
Energy Efficiency	Credit for energy-efficiency improvements to existing homes	3.0	12/31/2013
	Residential efficiency property credit	0.9	12/31/2016
	Credit for plug-in electric vehicles	0.4	Expires for each manufacturer when the number of vehicles it sells reaches the limit set by the government
	Credit for the production of energy-efficient appliances	0.2	12/31/2013
	Deduction for expenditures on energy-efficient commercial building property	0.2	12/31/2013
	Ten-year depreciation for smart meters or other devices for monitoring and managing electrical distribution	0.1	None
Renewable Energy	Credits for the production of electricity from renewable resources[a]	1.7	12/31/2013
	Credit for investment in advanced-energy property, including property used in producing energy from wind, the sun, or geothermal sources	0.3	Fixed dollar amount of credits; available until used
	Credit for investments in solar and geothermal equipment, fuel cells, and microturbines	0.5	12/31/2016
	Five-year depreciation for certain renewable energy equipment	0.3	None
Fossil Fuels	Option to expense depletion costs on the basis of gross income rather than actual costs	1.1	None
	Expensing of exploration and development costs for oil and natural gas	0.9	None
	Amortization of air pollution control facilities	0.4	None
	Option to expense 50 percent of qualified property used to refine liquid fuels	0.4	12/31/2013
	Credit for investment in clean-coal facilities	0.2	Fixed dollar amount of credits; available until used
	Fifteen-year depreciation for natural gas pipelines	0.1	12/31/2010[b]
	Amortization of certain expenditures associated with oil and gas exploration	0.1	None

Continued

Table 1. Continued

Energy-Related Tax Preferences in Fiscal Year 2013

Primary Target of Support	Tax Preference	Total Cost in 2013 (Billions of dollars)	Expiration Date
	Energy-Related Tax Preferences Affecting Income Taxes (Continued)		
Nuclear Energy	Special tax rate for nuclear decommissioning reserve funds	1.1	None
	Subtotal, Tax Preferences Affecting Income Taxes	11.9	n.a.
	Energy-Related Tax Preferences Affecting Excise Taxes[c]		
Renewable Energy	Excise tax credit for biodiesel	1.9	12/31/2013
	Grants in Lieu of Tax Credits[d]		
Renewable Energy	Section 1603 grants	2.6[e]	12/31/2011
	All Energy-Related Tax Preferences		
	Total	**16.4**	**n.a.**

Sources: Congressional Budget Office based on data from Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2012–2017*, JCS-1-13 (February 1, 2013), pp. 33-35, www.jct.gov/publications.html?func=startdown&id=4503, and *List of Expiring Federal Tax Provisions 2013–2023*, JCX-3-13 (January 11, 2013), www.jct.gov/publications.html?func=startdown&id=4499; and Office of Management and Budget, *Budget of the U.S. Government, Fiscal Year 2013: Appendix* (February 2012), p. 1068, www.whitehouse.gov/omb/budget/Appendix/.

Notes: The estimates of costs resulting from individual tax preferences do not account for any potential interactions between preferences and do not include tax provisions estimated to cost less than $50 million. Nor do they reflect the budgetary effects of eliminating those preferences and of taxpayers' adjusting their activities in response to those changes.

n.a. = not applicable.

a. The production tax credit is generally available for 10 years beginning on the date that a facility is put in service. The American Taxpayer Relief Act of 2012 defined eligible facilities as those whose construction began before January 1, 2014.

b. Effects of depreciation extend beyond the expiration date.

c. The Joint Committee on Taxation and the Administration generally do not estimate tax expenditures in the excise tax system. They do, however, provide information on revenue reductions from excise tax credits for alcohol and biodiesel.

d. Companies that began constructing a facility and applied for the grant before December 31, 2011, are eligible; because grants are paid when facilities are placed in service, they are still being disbursed.

e. The Office of Management and Budget has determined that the Section 1603 grants are subject to sequestration. CBO applied the sequestration percentages published by OMB for nondefense mandatory programs (5.1 percent) to the estimated 2013 spending on those grants.

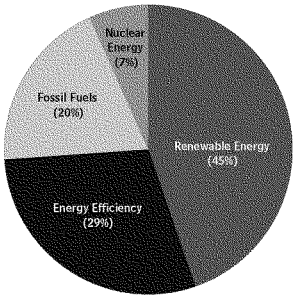
- $11.9 billion for energy-related preferences in the income tax system.[5]
  - The two most costly preferences are the credit for energy-efficiency improvements to existing homes ($3.0 billion) and the credits for electricity production from renewable resources ($1.7 billion—$1.4 billion for wind and $0.3 billion for biomass).
  - Energy efficiency accounts for the largest share of support offered through the income tax system ($4.8 billion), followed by fossil fuels ($3.2 billion).
- $1.9 billion for an excise tax credit for biodiesel.[6]

5. Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2012–2017*, JCS-1-13 (February 1, 2013), www.jct.gov/publications.html?func=startdown&id=4503.

6. Estimates provided by staff of the Joint Committee on Taxation. For a discussion of the effects of biofuel tax credits, see Congressional Budget Office, *Using Biofuel Tax Credits to Achieve Energy and Environmental Policy Goals* (July 2010), www.cbo.gov/publication/21444.

Figure 2.

Allocation of Energy-Related Tax Preferences in Fiscal Year 2013, by Type of Fuel or Technology



Sources: Congressional Budget Office based on data from the Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2012–2017*, JCS-1-13 (February 1, 2013), pp. 33–35, www.jct.gov/publications.html?func=startdown&id=4503; and the Office of Management and Budget.

Note: This figure encompasses all of the tax preferences listed in Table 1.

- $2.6 billion for grants under the Section 1603 program.[7] Those grants are primarily used by producers of wind-generated electricity.

In 2013, an estimated total of $7.3 billion, or 45 percent of the energy-related tax preferences, is directed toward renewable energy, and $4.8 billion, or 29 percent, is directed toward energy efficiency (see Figure 2).[8]

Expiration Dates for Provisions

Many of the tax provisions that target energy efficiency and renewable energy have expired or were extended through 2013 by the American Taxpayer Relief Act. Most of the support for energy efficiency and renewable energy in 2013 comes from provisions that are temporary. In contrast, most of the support for fossil fuels and nuclear energy comes from provisions that are permanent.

Provisions That Have Expired. The Section 1603 grant provisions expired on December 31, 2011—the last date on which projects could become eligible for the benefit. Facilities that were under construction as of that date qualify for the option to take the cash grant in lieu of tax credits, but the grants will be provided when the facility is put into service. Thus, some grants will be disbursed in 2013 or later.

The provision that allowed accelerated deprecation for natural gas pipelines expired on December 31, 2010. However, the effects of the preference extend beyond the expiration date.

Provisions That Have Been Extended. The American Taxpayer Relief Act extended the expiration date of four major tax credits related to fuels and energy technologies to December 31, 2013, and allowed the credits that expired on December 31, 2011, to be claimed retroactively. Specifically, the act extended the following major preferences:

- The credit for energy-efficiency improvements to existing homes,
- The credit for the production of energy-efficient appliances,
- The credits for the production of electricity from renewable resources, and
- The excise tax credit for biodiesel.

The act also changed the criteria used to determine eligibility for the tax credit for producers of electricity from renewable resources. Under the previous rules, producers would be eligible only if they had begun producing

7. The Office of Management and Budget (OMB) has determined that the Section 1603 grants are subject to sequestration. CBO applied the sequestration percentages published by OMB for nondefense mandatory programs (5.1 percent) to the estimated 2013 spending on those grants. For further discussion of the sequestration, see the section on "Financial Support for Energy Technologies in 2013" on page 7.

8. For a more detailed discussion of energy-related tax preferences, see Joint Committee on Taxation, *Present Law and Analysis of Energy-Related Tax Expenditures and Description of the Revenue Provisions Contained in H.R. 1380, the New Alternative Transportation to Give Americans Solutions Act of 2011*, JCX-47-11 (September 20, 2011), www.jct.gov/publications.html?func=startdown&id=4360.

electricity before the expiration date. The act redefined those criteria, making producers eligible for the credit as long as they began constructing the electricity-producing facility before the expiration date—that is, before January 1, 2014. The total estimated cost of the four tax preferences in 2013 is $6.8 billion.

Department of Energy Programs

In fiscal year 2013, DOE's funding (or budget authority) for fossil-fuel R&D, electrical energy, nuclear energy, energy efficiency, and renewable energy (all of which are referred to in this analysis as fuels and energy technologies) totals $3.4 billion.[9] Federal agencies are currently operating under a continuing resolution that generally provides funding at or near the same levels as in fiscal year 2012. (The continuing resolution expires on March 27, 2013.) The funding estimates for fiscal year 2013 presented in this testimony represent annualized versions of the budget authority provided by the continuing resolution, reduced to reflect the results of sequestration (that is, the across-the-board cuts mandated by the Budget Control Act of 2011) and specified in the sequestration report issued on March 1, 2013, by the Office of Management and Budget (OMB).

Virtually all of the relevant DOE funding is for direct investments by DOE rather than for making loans or loan guarantees. The $3.4 billion accounts for less than 20 percent of DOE's 2013 appropriations; much of that agency's funding is for maintaining the U.S. nuclear weapons stockpile and the environmental cleanup of old nuclear facilities. Other agencies also spend money in ways that affect the demand for and supply of energy. This testimony focuses only on DOE's expenditures that promote the development of specific fuels or energy technologies.[10]

9. Budget authority is the authority provided by law to incur financial obligations that will result in outlays of government funds.

10. Those amounts do not include, and this testimony does not address, the cost of energy-related activities of other agencies, such as leasing and resource-management programs of the Department of the Interior and programs supporting rural electricity production and transmission operated by the Department of Agriculture. This testimony also does not address the government's role in the production of electricity through such entities as the Tennessee Valley Authority and the Bonneville Power Administration.

Historical Trends

The Department of Energy was established in the late 1970s in response to a dramatic increase in oil prices. Throughout most of its history, DOE has supported energy technologies primarily by funding R&D and demonstration projects. DOE's initial funding for energy technologies was aimed at creating new domestic sources of energy. Budget authority for DOE's technology programs has varied significantly over the past three decades. In 1980, such programs received appropriations totaling about $10.6 billion (measured in 2013 dollars; see Figure 3). After 1980, however, the federal government's interest in funding the development of new energy sources waned. By 2000, appropriations for DOE's energy technology programs had fallen to about $2.2 billion (in 2013 dollars). DOE's funding for that purpose began to rise again in the 2000s, driven at least in part by concern about CO_2 emissions from the generation of electricity.

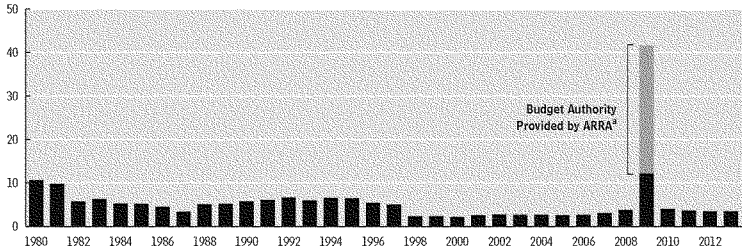
In 2009, DOE received $39 billion (in current dollars) for support of energy technologies (after accounting for rescissions and transfers)—roughly 17 times the average annual appropriation for the preceding decade. That funding comprised $27.6 billion in budget authority provided under ARRA and $11.4 billion in regular appropriations. Forty percent of the ARRA funding was for weatherization and for implementing other energy conservation measures, a much higher percentage than in most annual appropriations for DOE. Through loan guarantees or grants, ARRA also funded the manufacture of advanced batteries and other innovative energy technologies. The regular 2009 appropriation included $7.5 billion for the subsidy cost of loans for manufacturing advanced-technology vehicles. The credit subsidies are intended to be leveraged into loans with much larger face values.

Although ARRA funds have generally been spent more rapidly than funds that DOE has received through the normal appropriation process, roughly $5 billion of ARRA funding for the fuels and energy technology programs remains unspent. In particular, as of mid-February 2013, less than $1 billion of the $3.4 billion appropriated by ARRA for fossil-fuel programs had been spent. Several of the demonstration projects in the fossil-fuel program (mainly projects that would capture and sequester CO_2 emissions from coal-fired electricity generators) have been canceled by the private partners. What will happen

Figure 3.

DOE's Financial Support for Energy Technologies and Energy Efficiency

(Budget authority, in billions of 2013 dollars)



Source: Congressional Budget Office based on data from the Department of Energy, Office of the Chief Financial Officer, and the Office of Management and Budget.

Notes: As of the date of this testimony (March 13, 2013), no full-year regular appropriation bills have been enacted for fiscal year 2013. Instead, all agencies are operating under a continuing resolution that expires on March 27, 2013. The estimate of budget authority reflects the assumption that accounts are funded at the annualized level provided by the continuing resolution, as reduced by the across-the-board cuts mandated by the Budget Control Act of 2011.

DOE = Department of Energy.

a. Funding provided by the American Recovery and Reinvestment Act of 2009 (ARRA) reflects transfers and rescissions of budget authority for Section 1705 loan guarantees made after ARRA was enacted.

to the funds that had been allocated for those projects is unclear.

Financial Support for Energy Technologies in 2013

The $3.4 billion available to the Department of Energy in fiscal year 2013 for the development and production of fuels and energy technologies has two components: direct investments, which received $3.4 billion, and credit programs, which received $42 million (see Table 2 for the direct investments; the credit amounts are not listed in that table because they are less than $50 million).

The funding indicated in Table 2 reflects the results of the sequestration mandated by the Budget Control Act. As detailed by OMB, the sequestration reduced DOE's funding for fuels and energy technology programs by $181 million in 2013. The sequestration resulted in a 5 percent reduction in budget authority for most of the programs listed in Table 2.[11]

Direct Investments. Most of DOE's direct investments in support of specific energy technologies are currently divided into four general areas: energy efficiency and renewable energy, nuclear energy, fossil-fuel R&D, and electricity delivery and energy reliability. In addition, funding was provided for the Advanced Research Projects Agency-Energy, which funds high-risk research that has the potential for a high payoff for any of the four areas. The $3.4 billion for direct investments is allocated as follows (see Figure 4):

- 51 percent for energy efficiency and renewable energy, divided roughly equally between energy-efficiency programs (which focus on improving the efficiency of buildings and automobiles and provide grants for weatherization and conservation) and renewable-energy programs (which emphasize the development of solar, biomass, wind, and other such energy sources);

11. Part of the spending for the electricity delivery and energy reliability programs is classified as defense discretionary spending and so is subject to a 7.8 percent sequestration reduction. OMB reports that the amount sequestered in that program is less than $500,000.

Table 2.

DOE's Financial Support for Energy Technologies and Energy Efficiency in Fiscal Year 2013

	Budget Authority (Billions of dollars)
Direct Investments	
Energy efficiency and renewable energy	1.7
Nuclear energy	0.7
Fossil-energy research and development	0.5
Advanced Research Projects Agency—Energy	0.3
Electricity delivery and energy reliability	0.1
Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research Fund	*
Subtotal	3.4
Credit Programs	
Advanced Technology Vehicles Manufacturing Loan Program Account	*
Title 17 Innovative Technology Loan Guarantee Program	*
Total	**3.4**

Sources: Congressional Budget Office based on data from Office of Management and Budget, *OMB Report to the Congress on the Joint Committee Sequestration for Fiscal Year 2013* (March 1, 2013), www.whitehouse.gov/sites/default/files/omb/assets/legislative_reports/fy13ombjcsequestrationreport.pdf (1 MB).

Notes: As of the date of this testimony (March 13, 2013), no full-year regular appropriation bills have been enacted for fiscal year 2013. Instead, all agencies are operating under a continuing resolution that expires on March 27, 2013. The estimates of budget authority reflect the assumption that accounts are funded at the annualized level provided by the continuing resolution, as reduced by the across-the-board cuts mandated by the Budget Control Act of 2011.

DOE = Department of Energy; * = between zero and $50 million.

- 22 percent for nuclear energy programs (which focus on making reactors safer and cheaper), developing a sustainable nuclear fuel cycle, and maintaining federal nuclear energy research facilities;
- 15 percent for fossil-fuel R&D programs, primarily for reducing emissions, particularly of CO_2, from coal-fired electricity generation;
- 8 percent for the Advanced Research Projects Agency—Energy; and
- 4 percent for electricity delivery and energy reliability programs (which support improvements in the electricity grid that increase energy efficiency).

Credit Programs. DOE directs resources to promote the deployment of new energy technologies by providing loans and loan guarantees to private firms that bring them to market. In recent years, DOE has extended credit through three major programs:

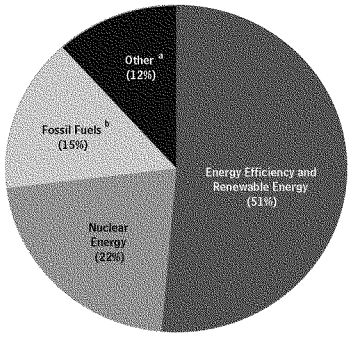
- The Advanced Technology Vehicle Manufacturing (ATVM) program—a permanent loan program that aims to improve the energy efficiency of automobiles;
- The Section 1705 program—a temporary loan guarantee program that supports loans for some renewable-energy systems, electric power transmission, and innovative biofuel projects; and
- The Section 1703 program—a permanent loan guarantee program that aims to increase investment in nuclear facilities or other innovative clean-energy facilities.[12]

DOE's credit programs operate under the rules established by the Federal Credit Reform Act of 1990 for calculating the budgetary cost of direct loans and loan

12. Together, the Section 1705 and Section 1703 programs are commonly referred to as the Title 17 program.

Figure 4.

Allocation of DOE's Direct Investments in Energy Technologies and Energy Efficiency, Fiscal Year 2013



Sources: Congressional Budget Office based on data from the Office of Management and Budget, *OMB Report to the Congress on the Joint Committee Sequestration for Fiscal Year 2013* (March 1, 2013), www.whitehouse.gov/sites/default/files/omb/assets/legislative_reports/fy13ombjcsequestrationreport.pdf (1 MB).

Notes: As of the date of this testimony (March 13, 2013), no full-year regular appropriation bills have been enacted for fiscal year 2013. Instead, all agencies are operating under a continuing resolution that expires on March 27, 2013. The estimates of budget authority reflect the assumption that accounts are funded at the annualized level provided by the continuing resolution, as reduced by the across-the-board cuts mandated by the Budget Control Act of 2011.

DOE = Department of Energy.

a. Includes electricity delivery and energy reliability and the Advanced Research Projects Agency—Energy.

b. Includes fossil-energy research and development and the Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research Fund.

guarantees issued by the federal government.[13] In general, before DOE (or any agency) can make loans or loan guarantees, lawmakers must provide funding sufficient to cover the government's cost of the loan, referred to as the subsidy cost. Funding for subsidy costs may be derived from an appropriation from the U.S. Treasury, and those costs can be reduced by fees paid by borrowers. Lawmakers control the amount of federal credit assistance either by appropriating the amount needed for the subsidies or, in cases in which gross subsidy costs are covered by fees, by setting limits on the volume of loans or loan guarantees.

The subsidy costs for DOE's loans and loan guarantees are the estimated lifetime costs of the credit assistance, which include losses from defaults—such as the loss that will result from the loan guarantee DOE provided for Solyndra, a manufacturer of photovoltaic systems that declared bankruptcy in 2011—net of any recoveries on the loan. Estimates of the risks of default, and the consequent budgetary costs, change as government agencies gain more experience with each loan or loan guarantee. As a result, the estimated subsidy cost of federal loans and loan guarantees is frequently revised over the life of a credit program. (Under the Federal Credit Reform Act, such revisions are determined by agencies and recorded in the budget as "credit reestimates" on an annual basis.)

Lawmakers initially provided subsidy funding for the ATVM program and for Section 1705 loan guarantees (primarily for renewable energy) but not for Section 1703 loan guarantees (primarily for nuclear power). In total, the ATVM program and the Section 1705 loan guarantees have received $10 billion in budget authority for subsidies (after accounting for rescissions and transfers). Most of the guarantees authorized under Section 1703 are intended to be self-supporting, with recipients paying a fee designed to cover the government's cost of providing the guarantee; however, DOE's 2011 appropriation included $170 million in subsidies for some of those loan guarantees. None of the credit programs received a subsidy appropriation for 2013, but DOE received $42 million for administrative expenses.

The estimated subsidy cost of the ATVM program and Section 1705 loan guarantees for fiscal years 2009 to 2012 totaled $4.0 billion on about $25 billion in loans

13. Estimates prepared pursuant to the Federal Credit Reform Act do not, however, provide a comprehensive measure of what federal credit programs actually cost the government. See Congressional Budget Office, *Fair-Value Accounting for Federal Credit Programs* (March 2012), www.cbo.gov/publication/43027.

and loan guarantees. DOE made loans totaling $9.1 billion to six manufacturers of advanced-technology vehicles, with an estimated subsidy cost of $1.6 billion.[14] Guarantee authority for the Section 1705 program expired on September 30, 2011, at which point DOE had made commitments for $15.6 billion in loan guarantees, with an estimated subsidy cost of $2.4 billion. Eighty percent of those loan guarantees went either to generators of solar power or to manufacturers of solar equipment. As of the end of 2012, DOE had not finalized any Section 1703 loan guarantees, although it is authorized to guarantee debt totaling $34 billion under that program (provided that recipients pay a fee covering the projected subsidy cost of those loans).

Cost-Effectiveness of Government Actions

The federal government's intervention in energy markets can be beneficial if it leads to a more efficient use of resources than would occur in a purely private market. It is most likely to be beneficial in cases in which private choices about the production or use of energy create external costs or spillover benefits—costs or benefits that are experienced by society as a whole rather than falling on firms or households in proportion to their production and consumption.[15]

Reducing External Costs Through the Tax System

Environmental costs are examples of external costs. The production and consumption of energy causes environmental damage that is not borne directly by households and firms in proportion to their production or use of energy. For example, coal combustion emits carbon dioxide as well as sulfur dioxide, which causes damage to downwind lakes and contains particulates that increase the incidence of asthma. Similarly, gasoline combustion releases CO_2 and smog-causing emissions that increase the incidence of respiratory-related illnesses and death. Without government intervention, environmental costs are not reflected in the prices charged for various fuels and energy services, so firms and households lack an incentive to take them into account when deciding what types and quantity of energy to produce and consume.

Some policymakers and analysts view the United States' dependence on oil as another source of external costs. Because many sectors of the U.S. economy—especially transportation—use oil, the United States is economically vulnerable to a disruption in the supply of oil. Reducing exposure to that disruption would require a large decrease in the total amount of oil consumed in the United States. To the extent that such vulnerability exists and does not affect consumers in direct proportion to their oil consumption, households and businesses will tend to use more oil than would be best from a societal perspective.

The most cost-effective way to reduce the external costs associated with energy would be to enact policies, such as taxes, that would increase the prices of various types of energy to reflect the external costs that their production and use entail. That approach would provide a financial incentive for businesses and households to consider those external costs when deciding on the types and amounts of energy to use.

In the absence of such price increases, the government could directly subsidize the investment in (or use of) technologies that lead to lower external costs, such as improvements in energy efficiency or the use of renewable energy. Subsidies, such as tax preferences or direct payments, are typically less cost-effective than incorporating external costs into energy prices, for at least three reasons:

- They may cause the government to pay firms or households to make choices about investment, production, or consumption that they would have made anyway in the absence of the subsidies;
- They typically support particular technologies, which may not be the least expensive method of reducing external costs; and

14. The ATVM program initially obligated $3.5 billion of its $7.5 billion in subsidy funds; DOE has since revised the estimated subsidy costs for those loans downward by $1.9 billion. In the case of the Section 1705 loan guarantees, DOE initially estimated that the subsidy costs would total $1.9 billion but has since raised that estimate by $0.5 billion.

15. For a more comprehensive discussion of those two types of market failures, see Congressional Budget Office, *Evaluating the Role of Prices and R&D in Reducing Carbon Dioxide Emissions* (September 2006), www.cbo.gov/publication/18131.

- They increase government expenditures or reduce revenues, which adds to the deficit or requires that the government pay for those subsidies by reducing other spending or by increasing other taxes, possibly those that discourage the productive use of labor and capital. (For example, taxes on labor income tend to reduce the amount of time that individuals choose to work.)[16]

Many of the tax preferences are directed toward technologies that have the potential to reduce the external costs of energy production and use. Of the cost of those preferences, 74 percent is for energy efficiency or renewable energy: Energy efficiency lowers external costs by reducing the total consumption of energy; renewable energy can reduce external costs because, in most cases, it produces lower emissions than do fossil-fuel alternatives.[17] Historically, however, tax preferences have been targeted toward encouraging, not discouraging, the use of fossil fuels, particularly oil. Under current law, most of the tax preferences for energy efficiency and renewable energy will expire, but most preferences for fossil fuels are permanent.

Increasing Spillover Benefits Through Support for R&D

Knowledge created by investments in R&D—for energy technologies as well as for many other types of technologies—may yield spillover benefits for society that do not translate into profits for the innovating firm. Legal arrangements, such as patents, help innovators capture some of the benefits that result from innovation (although they also tend to reduce the total benefits from those same innovations by limiting their spread). Spillover benefits are typically largest from basic research, which can create general scientific knowledge that cannot be subject to patents, and diminish as technologies approach commercial production. Although the inability of innovators to fully capture the benefits of their work is not a circumstance unique to energy R&D, that inability leads to an inefficiently low level of R&D on technologies that might reduce pollution or the consumption of oil.

A large share of DOE's spending on energy technologies has been directed toward R&D. One comprehensive review of research indicates that government funding of energy R&D has yielded benefits greater than its costs in many cases.[18] Different types of energy R&D have produced very different returns. In general, funding aimed at the early stages of developing a technology, such as basic research, has been more likely to yield benefits in excess of costs than has funding for demonstration projects.[19] Moreover, DOE's handling of demonstration projects has long been criticized by the Government Accountability Office and others because of inadequacies in DOE's project management.[20]

One review of the literature on DOE's efforts to develop renewable energy sources concluded that a large proportion of government-sponsored R&D focused on those sources—wind and solar thermal energy, for example—has been technically successful.[21] However, such sources constitute just a small share of today's market, in part because the prices of conventional sources of energy do not reflect the external costs of their production and consumption. That review also concluded that the forecasts of cost reduction for those sources of energy were generally achieved but that the forecasts of market

16. Taxes that reflect external costs can also indirectly reduce incentives to work and invest by lowering inflation-adjusted returns on labor and capital (if prices rise and wages and returns on capital do not). That indirect effect, referred to as the tax interaction effect, can be at least partially offset by using the revenue generated by the tax that reflects external costs to reduce taxes that discourage the use of labor and capital.

17. For a more detailed discussion of whether renewable fuels, such as ethanol, might lead to decreases in greenhouse gas emissions, see Congressional Budget Office, *The Impact of Ethanol Use on Food Prices and Greenhouse-Gas Emissions* (April 2009), www.cbo.gov/publication/41173.

18. National Research Council, *Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000* (National Academy Press, 2001), www.nap.edu/openbook.php?isbn=0309074487.

19. For a more comprehensive discussion, see Congressional Budget Office, *Federal Climate Change Programs: Funding History and Policy Issues* (March 2010), www.cbo.gov/publication/21196.

20. See, for example, Government Accountability Office, *Department of Energy: Consistent Application of Requirements Needed to Improve Project Management*, GAO-07-518 (May 2007), www.gao.gov/products/GAO-07-518.

21. See James McVeigh and others, *Winner, Loser, or Innocent Victim? Has Renewable Energy Performed as Expected?* Discussion Paper 99-28 (Resources for the Future, 1999), www.rff.org/Publications/Pages/PublicationDetails.aspx?PublicationID=17068.

penetration and sales were generally overstated. The authors of the study also concluded that one of the major factors contributing to the lack of commercial success of the renewable-energy technologies was the decline in the inflation-adjusted price of oil during the forecast period. Other factors included changes in the structure of the markets for electricity generation and changes in the regulation of railroads that decreased the delivered price of coal. In sum, although the price of renewable energy fell, so did the price of fossil energy. Because consumers did not pay for the external costs of their consumption of fossil fuels, those energy sources retained a commercial advantage.

About This Document

This testimony updates *Federal Financial Support for the Development and Production of Fuels and Energy Technologies*, a report written by Philip Webre and Terry Dinan that the Congressional Budget Office (CBO) released in March 2012. In keeping with CBO's mandate to provide objective, impartial analysis, this testimony contains no recommendations.

Mark Booth, Megan Carroll, Kathleen Gramp, and Logan Timmerhoff of CBO contributed significantly to the analysis on which this testimony is based, and Vi Nguyen fact-checked it. Joseph Kile and Chad Shirley supervised that work. Useful comments were provided by Christopher Overend of the Joint Committee on Taxation. The assistance of an external reviewer implies no responsibility for the final product, which rests solely with CBO.

Sherry Snyder edited the testimony, and Jeanine Rees and Maureen Costantino prepared it for publication. The testimony is available on CBO's website (www.cbo.gov).

Terry Dinan is a Senior Advisor at the Congressional Budget Office. While at CBO she has written about a variety of environmental and energy issues, including numerous studies on the design of climate policies and their implications for households and businesses in the U.S., the costs and consequences of higher CAFE standards, and the costs and effects of policies aimed at subsidizing energy sources and technologies, Her position entails communicating (in both written and oral formats) technical research to both technical and non-technical audiences, including lawmakers, Congressional staff, industry groups, environmental groups, academics, and foreign policy officials. She has published in a variety of professional journals and served as an associate editor for the Journal of Environmental Economics and Management. She has a Ph.D. in economics from Iowa State University. Prior to coming to CBO she worked at the Environmental Protection Agency.

Chairwoman LUMMIS. Thank you, Dr. Dinan.

I would now like to recognize Ms. Hutzler to present her testimony.

STATEMENT OF MS. MARY HUTZLER,
DISTINGUISHED SENIOR FELLOW,
INSTITUTE FOR ENERGY RESEARCH

Ms. HUTZLER. Chairman Lummis, Ranking Member Swalwell, and Members of the Subcommittee, thank you for the invitation to testify.

The Institute for Energy Research is a nonprofit free-market think tank that researches global energy trends. Today's hearing touches upon one of the Nation's more important policy questions: What is the Federal Government's authority to ensure a stable, affordable, and reliable energy future; power our economy; create jobs; and strengthen our global position?

Tied to this question are concerns about our Nation's fiscal strain, the need for new revenues, and Congress' responsibility to eliminate wasteful spending and bringing federal budget outlays under control. Similarly, Congress and federal regulators must be careful to encourage, rather than discourage, the responsible development of America's vast energy resources, the majority of which are currently being produced on nonfederal lands.

Recent years have seen a dramatic increase in federal energy subsidies, with the largest increases going to renewable and end-use subsidies. Between 2007 and 2010, federal energy subsidies increased from almost $18 billion to over $37 billion. Renewable energy subsidies increased by 186 percent, with wind receiving a tenfold increase and solar increasing by a factor of 6. Biofuel subsidies increased by 66 percent and conservation subsidies increased from $369 million in 2007 to more than $6.5 billion in 2010. Fossil fuels also received increased federal support with coal subsidies increasing to $1.3 billion and oil and natural gas subsidies increasing to $2.8 billion. Nuclear subsidies increased 46 percent from $1.7 billion to $2.5 billion. Clearly, Washington has been on a spending spree.

The largest single contributor to this spending was the American Recovery and Reinvestment Act of 2009, also known as the stimulus bill. By itself, this legislation accounted for 40 percent of the total subsidy value in 2010 and 77 percent of the increase in subsidies from fiscal 2007.

To put these increases in the proper perspective, it is critical to consider the return on investment that the American people have received. In other words, how have the subsidies for different fuels and technologies compared with production levels? Fossil fuels received 19 percent of the subsidies in 2010 that provided 77 percent of the production. Conversely, renewable fuels received 69 percent of the subsidies but produced only 11 percent of the country's energy.

These numbers prove more disconcerting when we look at federal spending on subsidies for electricity generation. In this sector, renewable energy received 55 percent of the subsidies that generated about 10 percent of the electricity, mostly from hydroelectric power.

Wind was the largest subsidies recipient, with 42 percent, yet wind provided only 2.3 percent of our electricity needs in 2010.

Clearly, the fuels and technologies that receive the overwhelming share of federal subsidies are not producing the largest portion of our energy needs. It is unlikely that this trend will change in the foreseeable future, yet the political support for renewables continue. IER calculated the federal subsidies and support per unit of electricity production from government data. According to our calculations, solar received over 1,100 times the subsidies coal, oil, and natural gas received, while wind was subsidized over 80 times more than these conventional fuels. Proponents of increased federal subsidies continue to claim that solar and wind are infant technologies, yet these technologies are not new. Wind, for example, has been used to generate electricity for more than 125 years.

Proponents have also used job numbers to demand a continuation of subsidies for renewables with the wind industry winning another year and more than $12 billion through expansion of the Production Tax Credit. Simply put, the lion's share of taxpayer dollars is spent on less-reliable energy sources that provide negligible benefit to consumers, present increased challenges for our electricity grid, and do little to diminish our reliance on base-load fuels and fail to support the American jobs they purport to create.

To date, over 50 firms receiving taxpayer dollars are either bankrupt or failing financially. Many of these companies had or currently have political connections in Washington. Even more appalling is the fact that subsidies used to support green energy ventures serve only to make high-income consumers pay marginally less for expensive luxury items, such as electric vehicles, and do nothing to help millions of Americans struggling to pay higher energy costs on lower take-home pay.

The history of subsidies is clear. Washington has a terrible track record of picking winners and losers. Subsidies take money from taxpayers, do not create the jobs that are claimed, and force our energy dependence on government by removing the market incentive for companies to make their technologies cost-competitive. Subsidies offset private-sector financing, waste taxpayer money on projects that would never make it off the ground if not for the political connections and the funding that these green energy projects receive. If a technology is truly competitive, it would make it in the marketplace on its own without massive government support.

Thank you for the opportunity to testify.

[The prepared statement of Ms. Hutzler follows:]

INSTITUTE FOR ENERGY RESEARCH

BEFORE THE ENERGY SUBCOMMITTEE

COMMITTEE ON SPACE, SCIENCE, AND TECHNOLOGY

HEARING ON FEDERAL FINANCIAL SUPPORT FOR ENERGY TECHNOLOGIES: ASSESSING THE COSTS AND BENEFITS

MARCH 13, 2013

TESTIMONY OF MARY J. HUTZLER

THE INSTITUTE FOR ENERGY RESEARCH

The Institute for Energy Research (IER) is a non-profit organization that conducts research and analysis on the functions, operations, and government regulation of global energy markets. IER articulates free market positions that respect private property rights and promote efficient outcomes for energy consumers and producers. IER staff and scholars educate policymakers and the general public on the economic and environmental benefits of free market energy. The organization was founded in 1989 as a public foundation under Section 501(c)(3) of the Internal Revenue Code. Funding for the institute comes from tax-deductible contributions of individuals, foundations, and corporations.

The federal government has provided various forms of financial support for the development and production of fuels and energy technologies over the past several decades and that support is growing. The Energy Information Administration (EIA), an independent agency of the U.S. Department of Energy (DOE), evaluated the amount of subsidies that the federal government provides energy producers with its most recent information for fiscal year 2010.[i] Over a 3-year period, from fiscal year 2007 through fiscal year 2010, total federal energy subsidies increased from $17.9 billion to $37.2 billion, an increase of 108 percent over the 3-year period. The largest increases in federal energy subsidies were in renewable and end-use subsidies. Over the 3-year period:

- Renewable energy subsidies increased by 186 percent from $5.1 billion to $14.7 billion.
- Wind led the various renewables with a more than 10-fold increase in subsidy from $476 million to $4,986 million.
- Solar subsidies increased by more than a factor of 6 from $179 million to $1134 million.
- Subsidies for biofuels increased by 66 percent, from $4 billion to $6.6 billion.

- Conservation and end-use subsidies more than tripled from $4 billion to $14.8 billion. Conservation subsidies increased from $369 million to $6,597 million, a factor of almost 18. End-use subsidies increased from $3,618 million to $8,241 million, more than a doubling.

In contrast,

- Federal subsidies for coal increased 44 percent from $943 million to $1,358 million.
- Federal subsidies for oil and natural gas increased 40 percent from $2,010 million to $2,820 million.
- Federal subsidies for nuclear energy increased 46 percent from $1,714 million to $2,499 million.

New legislation, particularly the American Recovery and Reinvestment Act (ARRA) of 2009, was a major factor in the increase in subsidies over the 3-year period. ARRA, by itself, represented 40 percent of the total subsidy value in FY 2010, and 77 percent of the increase in subsidies from FY 2007. Other legislation impacting the increased subsidy levels were the Energy Improvement and Extension Act, the Food, Conservation, and Energy Act of 2008 that provided new subsidies to biofuel producers, and the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 that extended the sunset dates for several tax expenditure programs and the grant program for qualifying renewables.

The growth in renewable fuel subsidies in FY 2010 is driven mainly by the $4.2 billion in expenditures for grants under Section 1603 of ARRA, which went mainly to wind facilities, and also in growth in support of biofuels. The 1603 program allowed qualifying renewable projects to receive an up-front grant in lieu of a production tax credit taken over 10 years for wind facilities. Tax expenditures relating to the ethanol tax credit increased over the three-year period due to the growth in ethanol blending under the Renewable Fuel Standard. Because the DOE Loan program was in its early stages in FY 2010, only $1.6 billion of the subsidies EIA calculated were attributed to it, but EIA acknowledged that expenditures from that program would be much higher in later years.

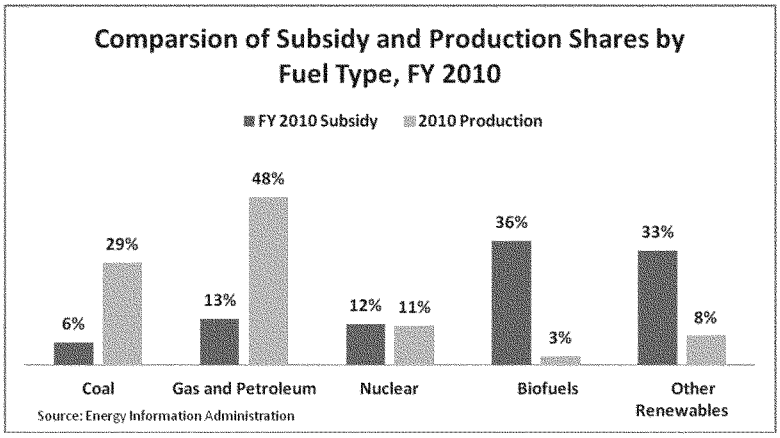
The subsidies covered in EIA's report include:

- Direct Expenditures to Producers and Consumers, which involve direct cash outlays that provide a financial benefit to producers or consumers of energy.
- Tax Expenditures, which are provisions in the tax code that reduce the tax liability of firms or individuals that take specified actions affecting energy production, consumption, or conservation.
- Research and Development expenditures that either increase energy supplies or improve the efficiency of energy technologies in the future.
- Loans and Loan Guarantees that, according to DOE, provide financial support for "innovative clean energy technologies that are typically unable to obtain conventional private financing due to their 'high technology risks.'"

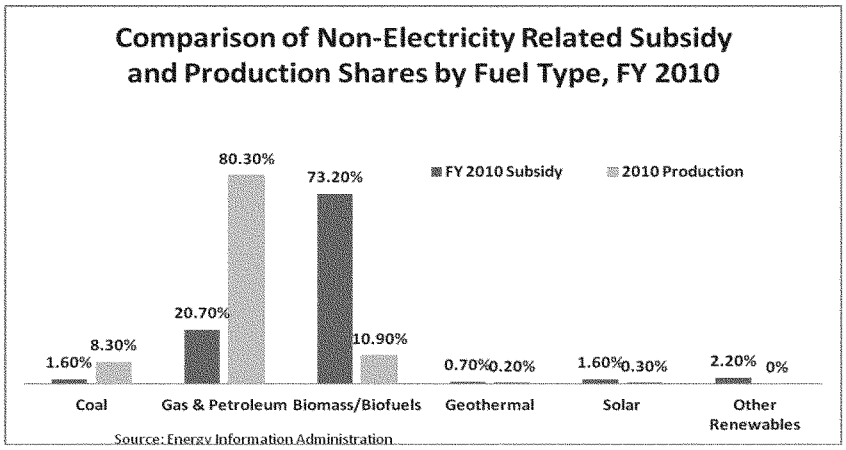
- Electricity programs serving targeted categories of electricity consumers including the federally-owned Tennessee Valley Authority and the Power Marketing Administrations whose electricity is sold preferentially to public bodies and cooperatives.

Subsidy Value by Fuel/Technology

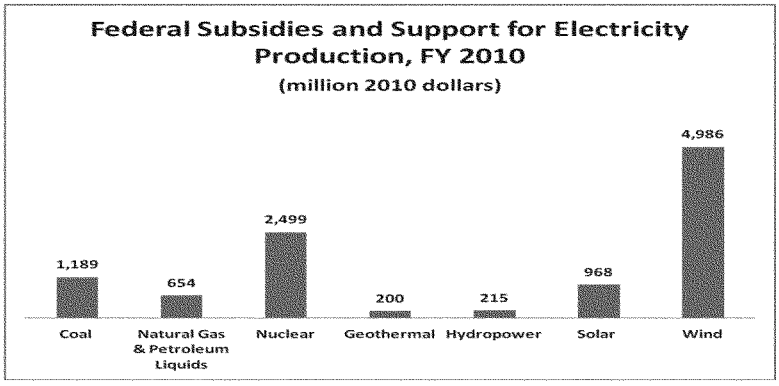
While all subsidy levels increased over the 3-year period, the subsidy levels for the different fuels/technologies were not in concert with their production levels. The following graph compares the share of subsidy received in fiscal year 2010 compared to the share of energy produced by each fuel/technology in 2010. Fossil fuels provided the largest share of production (77 percent), but received only 19 percent of the subsidies, while renewable fuels received 69 percent of the subsidies, but produced only 11 percent of the country's energy. The remainder of the subsidies was provided to nuclear energy which produced about an equivalent share of energy to its share of subsidies.



In the non-electric generating sector, biofuels/biomass received the largest share of non-electric subsidies (73 percent) but provided just 11 percent of the non-electric production. Petroleum and natural gas provided the largest share of non-electric production (80 percent), but received only 21 percent of the non-electric subsidies. Clearly, the fuels/technologies receiving the greatest shares of subsidies are not producing the largest amount of production.

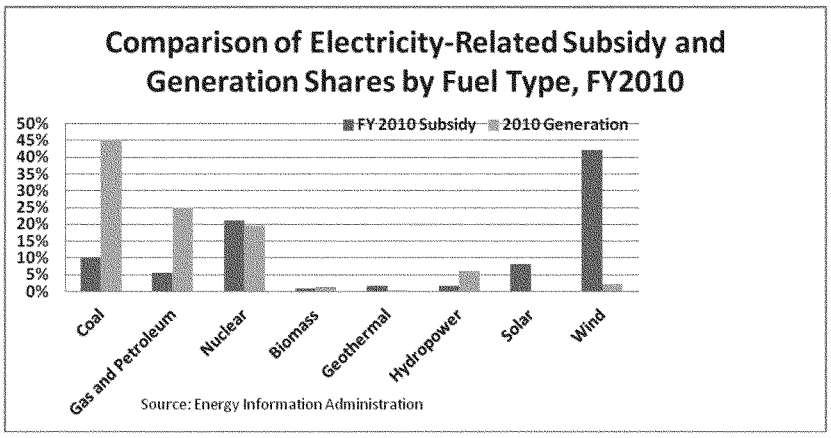


The main focus of the EIA report, however, was on subsidies for electricity generation. Federal subsidies for electricity production increased from $6,582 million to $10,902 million, an increase of 66 percent, with the largest dollar amounts received by wind ($4,986 million) and nuclear ($2,499 million) technologies. See the chart below.



Source: Energy Information Administration, *Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2010*, July 2011, http://www.eia.gov/analysis/requests/subsidy/pdf/subsidy.pdf

In the electric generation sector, renewable energy received 55 percent of the subsidies, but generated about 10 percent of the electricity. Wind was the largest renewable subsidy recipient with 42 percent of the subsidy, but provided only 2.3 percent of the electricity generated. Fossil fuels received 16 percent of the subsidies but generated the largest share of electricity--70 percent. Nuclear energy generated 20 percent of the electricity and received 21 percent of the subsidies—about an equal share of both. (Transmission and distrbution received 8 percent of the subsidies but is not displayed on the chart below because those subsidies were not apportioned to fuel/technology.)

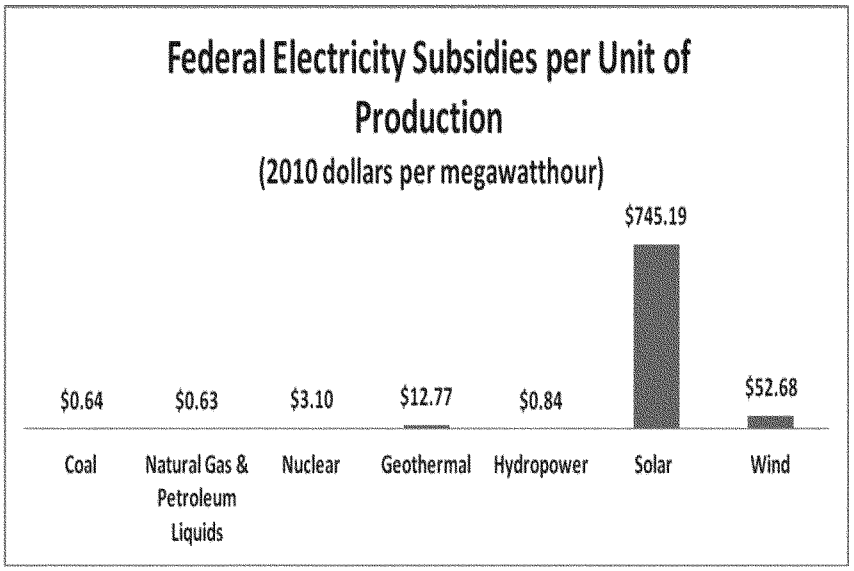


Federal Subsidies per Unit of Electricity Production

As mentioned above, renewable energy received 55 percent of federal subsidies and support in FY2010, but accounted for only 10 percent of total generation. While this statement is true, the difference is skewed much more than presented by these statistics because hydroelectric power provides the largest share of renewable generation (about 60 percent), but received only 0.6 percent of all subsidies and 1.5 percent of all renewable subsidies. A better measure is the value of the subsidy per unit of electricity production, which is an indicator of how federal dollars are being used and the value the nation is getting from them.

The Institute for Energy Research calculated the federal subsidies and support per unit of electricity production from the information provided in EIA's report. The ratio of dollars to production is given in the following figure. As can be seen by the figure, solar is being subsidized by over 1100 times more than coal and oil and natural gas electricity production, and wind is being subsidized over 80 times more than

the more conventional fossil fuels on a per unit of production basis. EIA's report shows that on a total dollar basis, wind energy has the highest federal subsidy, but, on a unit of production basis, solar energy is by far the costliest form of electricity production.



Source: Energy Information Administration, *Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2010*, July 2011, http://www.eia.gov/analysis/requests/subsidy/pdf/subsidy.pdf

Proponents of subsidies claim that wind and solar are "infant technologies" and need subsidies to be competitive in the market place. But these technologies are not new. Wind was first used to generate electricity over 125 years ago when James Blyth, a Scottish electrical engineer, pioneered the field of electricity generation through wind power --his wind turbine was the world's first-known structure by which electricity was generated from wind power. Although Blyth received recognition for his contributions to science, electricity generation by wind power was considered uneconomical. Similarly, the first photoelectric solar cell was built in the 1880s and the first practical photovoltaic solar cell was built in 1954--almost 60 years ago. Yet, these technologies are still uneconomic without subsidies and/or mandates.

The CBO Study

The Congressional Budget Office (CBO) evaluated federal subsidies received by the various energy industries for fiscal year 2011, classifying subsidies by two categories: tax preferences, which totaled

$20.5 billion in fiscal year 2011, and DOE's spending programs, which totaled $3.5 billion.[ii] (Tax preferences are defined as special tax rates and deductions, tax credits, and grants in lieu of tax credits.)

The agency found that energy-related subsidies totaled $24 billion in FY 2011, of which $16 billion (67 percent) were spent on renewable energy and energy efficiency and $2.5 billion (10 percent) on fossil fuels. In other words, renewable energy technologies and energy efficiency programs received 6.4 times more subsidies than fossil fuels received.

Because the EIA used a broader definition for what constitutes a subsidy, its study showed a higher level of federal subsidies ($37 billion) in fiscal year 2010 than the CBO found a year later ($24 billion), even though the American Reinvestment and Recovery Act had been in effect for a year longer in the CBO study. Using the broader definition, the EIA study found that federal energy-related subsidies and financial interventions totaled $37.2 billion, of which $21.3 billion was for renewable energy and energy efficiency (57 percent) and $4.2 billion was for fossil fuels (11 percent). Both studies were in agreement that biofuels and wind were the largest renewable recipients of subsidies. But, EIA also found that the largest recipients of subsidies also produced the smallest amounts of energy for the nation.

Tax Preferences

Energy-related tax preferences were initiated in 1916, but had dwindled to a very small amount by the late 1980s and did not grow substantially again until the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007 were enacted. These acts were followed by the Emergency Economic Stabilization Act of 2008 and the American Recovery and Reinvestment Act of 2009, which expanded and extended the provisions related to energy efficiency and renewable energy.

By fiscal year 2011, energy efficiency and renewable energy accounted for 78 percent of the estimated budgetary cost of federal energy-related tax preferences. According to the CBO, the breakdown of tax preferences for fiscal year 2011 was: renewable energy (68 percent), fossil fuels (15 percent), energy efficiency (10 percent), nuclear energy (4 percent), and other (2 percent).

About half of the total subsidies were from four tax provisions that expired at the end of December 2011. They totaled just over $12 billion, accounting for about 60 percent of the budgetary impact in 2011 of the energy-related tax preferences. One of the expired provisions was a renewable energy tax credit for the use of alcohol fuels that totaled over $6 billion. The other 3 provisions were credits for energy-efficiency improvements to existing homes ($1.5 billion), excise tax credit for biodiesel ($0.8 billion), and section 1603 grants for renewable energy ($3.9 billion), some of which have been extended by the American Taxpayer Relief Act of 2012.

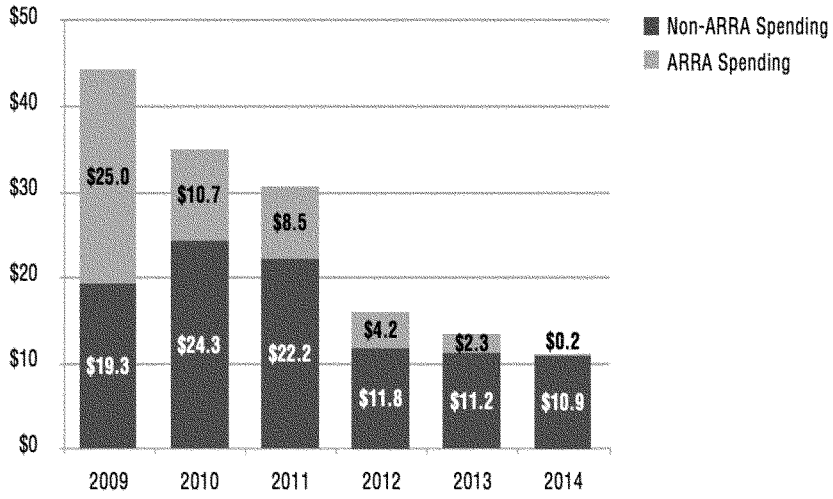
DOE Loan and Loan Guarantees

The stimulus funding in 2009 from the American Recovery and Reinvestment Act (ARRA) totaled $787 billion[iii], and most of those funds have been paid out according to the government's website[iv]. Over $90 billion was earmarked for 'green programs.' However, the total that went to green energy projects is not

clear. Brookings estimated it at $51 billion, with a total government spending (both stimulus and non-stimulus) on green initiatives at $150 billion through 2014.[v] About $100 billion (two-thirds) of that is expected to fund renewable energy, including subsidies for wind, solar and biofuel projects and research and development for new technologies. Conservation is expected to garner another $15 billion, funding for electric cars and high speed rail about $10 billion each, and smart grid and nuclear power about $6 billion each.

Figure 7

Federal ARRA and Non-ARRA Spending on Clean Tech by Year (billions)



Source: Brookings, Beyond Boom & Bust, April 2012, http://www.brookings.edu/~/media/Research/Files/Papers/2012/4/18%20clean%20investments%20muro/0418_clean_investments_final%20paper_PDF.PDF

Unfortunately, about 50 firms receiving government funds are either bankrupt (23) or are having difficulties (27), and many of the latter are in financial trouble.[vi] Over $15 billion of taxpayer money is either gone or at risk. Further, 29 of the 50 companies had or have political connections, putting the percentage of political cronyism at almost 60 percent.

Let's recap some of the loan commitments and their status. The most famous is Solyndra, a solar manufacturer that received almost all of the $535 million loan awarded it before filing for bankruptcy in 2011. The cause of Solyndra's demise was its complicated technology that required a custom manufacturing facility and an expensive price tag. Political desires resulted in DOE pushing the loan guarantee out the door quickly despite concerns over the economic and technological viability of the company to the detriment of the American taxpayers.

Abound Solar, another solar manufacturer that received a DOE loan guarantee for $400 million, filed for bankruptcy in June 2011 after it had laid off 70 percent of its workforce that February.[vii] According to the Daily Caller, Abound Solar sold defective or underperforming products, and company personnel claimed DOE officials knew their panels were faulty before they received taxpayer dollars.[viii] Virtually all of the panels Abound manufactured underperformed, putting out between 80 and 85 percent of the promised wattage and leading to tens of thousands of panels having to be replaced, particularly towards the end of the company's life.

First Solar, one of the biggest recipients from DOE's loan guarantee program, garnered over $3 billion[ix] before the program expired at the end of September 2011.[x] At the time, DOE was under pressure not to repeat its prior mistakes, but again the agency provided a loan guarantee to a losing company. For example, early in 2012, First Solar laid off half of its employees at its Antelope Valley Solar Ranch One project in the Southern California desert, which was the recipient of a $646 million loan guarantee that was to create 350 construction and 20 permanent jobs. Further exploiting taxpayers dollars, in 2011, First Solar paid its top eight executives almost $16 million. Rob Gillette, who was terminated as CEO of First Solar in October 2011, received more than $32 million since his employment began in October 2009. First Solar sold much of its $3 billion in federal loan guarantees to third parties before it laid off 30 percent of its workforce. Its stock price plummeted by more than 90 percent from its high in 2011, but not before its head officer received more than$329 million in stock sales since 2009.

Solar technology firms were not the only companies that received DOE awards, but failed to materialize any benefits. Fisker Automotive, a Finnish electric car maker, originally received $529 million in DOE loan guarantees, but was cut off at $193 million because it failed to reach milestones for its luxury vehicle Karma. The company suffered recalls of its extended-range electric sedan that cost over $100,000, because of technology flaws and failed batteries, which resulted in fires. The federal subsidies attracted some of the rich and famous, as it has been a favorite status purchase for Hollywood movie stars and celebrities, rappers and Hip Hop musicians, and soap opera stars. Consumer Reports gave the Karma a terrible review, calling it the worst luxury sedan on the market.

Fisker's battery supplier, A123 Systems, supplied the defective batteries. A123 Systems declared bankruptcy in October 2012, but not before receiving $132 million from its $279 million DOE loan guarantee to refurbish two Michigan plants plus other projects.[xi] Here again the loan guarantee was moved quickly by DOE. Similar to First Solar, A123's officers and directors made more than $11 million in stock sales before the bankruptcy filing.

It is not just the Fisker electric vehicles that are costly. So is Chevy's Volt that is being purchased by buyers with salaries at the $170,000 level, according to General Motors.[xii] The DOE and others indicate that battery costs need to come down to $350 per kilowatt-hour to make electric vehicles competitive in the market place.[xiii] John Gartner, an analyst with Pike Research, estimates battery costs to be around $900 per kilowatt hour, and expects them to decline by 10 to 15 percent per year, reaching about $470 per kilowatt hour by 2015. Others are more pessimistic on the cost reductions seeing a battery breakthrough taking at least 10 years.[xiv]

But what is even more striking is the difference in automobile characteristics. A gasoline vehicle has a range of 400 miles, while the range of an electric vehicle is 100-300 miles with recharging taking 4 to 12 hours, depending on the vehicle and the charger. That compares to a 5 minute fill-up for an internal combustion engine at a gasoline station. Plus, storage is more limited in electric vehicles due to the space needed for the battery. Further, while there are numerous stations to get a fill-up, the infrastructure for recharging stations doesn't exist in this country. That means these vehicles will have limited use, restricting their purpose to running errands in the local area or for a round-trip work commute. However, even then, one needs to be cautious regarding traffic patterns for heavy traffic can reduce the vehicle's range.

U.S. automobile manufacturers know that even if they manufactured the electric vehicles, they would be purchased only by a very small niche market.[xv] A recent report by the Center for Automotive Research estimates at best less than a half million electric vehicles would be on the road by 2015 based on deployment rates of hybrid vehicles.[xvi] According to Stanford University's Precourt Energy Efficiency Center, it took hybrids, which do not have the range and infrastructure issues of electric vehicles, over a decade to garner 3 percent of the sales market.[xvii]

Deloitte Consulting interviewed industry experts and 2,000 potential buyers and found that only "young, very high income individuals," making more than $200,000 a year, would consider purchasing an electric car sometime during the next 10 years. While there are people who may want to own such a car, the cost of around $40,000, even with the $7,500 rebate, is still double the cost of some internal combustion engines. For example, a 2011 Chevy Volt sells for $40,280; a Mercedes-Benz C350 sells for $39,990.[xviii] Tesla Motors will start its Model S sedan, which has a 160 mile driving range in ideal conditions, at $57,400.[xix] With larger battery packs, Tesla can expand the driving range. For an extra $10,000, Tesla will provide an electric vehicle that can go 230 miles on a charge, and for an extra $20,000, it will provide a vehicle that can go 300 miles.

The Heritage Foundation put together a list of 34 companies that received federal support from taxpayers that have faltered or are now faltering.[xx] These companies have either gone bankrupt, laid off workers, or are heading for bankruptcy. The list below provides the 34 companies along with the amount of money they were offered by the U.S. DOE and other federal government agencies. The amount of money listed does not include other state, local, and federal tax credits and subsidies and it also does not include government mandates, which guarantee a market for the product. The at-risk total

is approximately $7.5 billion, of which $1.6 billion is in receivership. And the total will likely get larger as more is known about each company.

1. Evergreen Solar ($25 million)*
2. SpectraWatt ($500,000)*
3. Solyndra ($535 million)*
4. Beacon Power ($43 million)*
5. Nevada Geothermal ($98.5 million)
6. SunPower ($1.2 billion)
7. First Solar ($1.46 billion)
8. Babcock and Brown ($178 million)
9. EnerDel's subsidiary Ener1 ($118.5 million)*
10. Amonix ($5.9 million)
11. Fisker Automotive ($529 million)
12. Abound Solar ($400 million)*
13. A123 Systems ($279 million)*
14. Willard and Kelsey Solar Group ($700,981)*
15. Johnson Controls ($299 million)
16. Schneider Electric ($86 million)
17. Brightsource ($1.6 billion)
18. ECOtality ($126.2 million)
19. Raser Technologies ($33 million)*
20. Energy Conversion Devices ($13.3 million)*
21. Mountain Plaza, Inc. ($2 million)*
22. Olsen's Crop Service and Olsen's Mills Acquisition Company ($10 million)*
23. Range Fuels ($80 million)*
24. Thompson River Power ($6.5 million)*
25. Stirling Energy Systems ($7 million)*
26. Azure Dynamics ($5.4 million)*
27. GreenVolts ($500,000)
28. Vestas ($50 million)
29. LG Chem's subsidiary Compact Power ($151 million)
30. Nordic Windpower ($16 million)*
31. Navistar ($39 million)
32. Satcon ($3 million)*
33. Konarka Technologies Inc. ($20 million)*
34. Mascoma Corp. ($100 million)

*Denotes companies that have filed for bankruptcy.

Loan guarantees continued even though the administration knew of its problems. A memorandum on the green energy loan guarantee program by high ranking officials inside the administration highlighted its numerous flaws.[xxi] According to the memorandum's authors (Larry Summers, Ron Klain, Carol

Browner)[1], one wind project in particular would receive $1.2 billion in government subsidies for a $1.9 billion project, making it about 65 percent subsidized while guaranteeing a 30-percent return on equity to private companies. And, the authors omit that the project would only create 400 construction jobs and 35 permanent jobs. In other words, each one of the 35 permanent jobs would cost the government over $30 million each.

The memorandum explains that the Office of Management and Budget (OMB) and the Department of Treasury were concerned about three problems with the loan guarantee program: "double dipping" (massive government subsidies from multiple sources), lack of "skin in the game" from private investors and "non-incremental investment," the funding of projects which would occur even without the loan guarantee.

For example, the Shepherds Flat wind project received over $1.2 billion in government subsidies, dwarfing the $100 million investment in the project touted by Google. Shepherds Flat is an 845-megawatt wind farm in Oregon. The $1.9 billion project would consist of 338 GE wind turbines manufactured in South Carolina and Florida and, upon completion, would represent the largest wind farm in the country. The sponsor's (Caithness Energy and GE Energy Financial Services) equity is about 11 percent of the project costs, but the project would generate an estimated return on equity of 30 percent.

Subsidy Type	Approximate Amount (millions)
Federal 1603 grant (equal to 30% investment tax credit)	$500
State tax credits	$18
Accelerated depreciation on Federal and State taxes	$200
Value of loan guarantee	$300
Premium paid for power from state renewable electricity standard	$200
Total	$1,218

Double dipping: The total government subsidies are about $1.2 billion from 5 different incentives.

Skin in the game: The government would provide a significant subsidy (about 65 percent), while the sponsor would provide little skin in the game (equity about 11%).

[1] At the time, Summers was the Chairman of the National Economic Council, Klain was Vice President Biden's Chief of Staff, and Browner was the White House Energy and Climate Change Advisor.

Non-incremental investment: This project would likely move without the loan guarantee. The economics are favorable for wind investment given tax credits and state renewable energy standards. GE signaled through Hill staff that it considered going to the private market for financing out of frustration with the review process. The return on equity is high (30 percent) because of tax credits, grants, and selling power at above-market rates, which suggests that the alternative of private financing would not make the project financially non-viable.

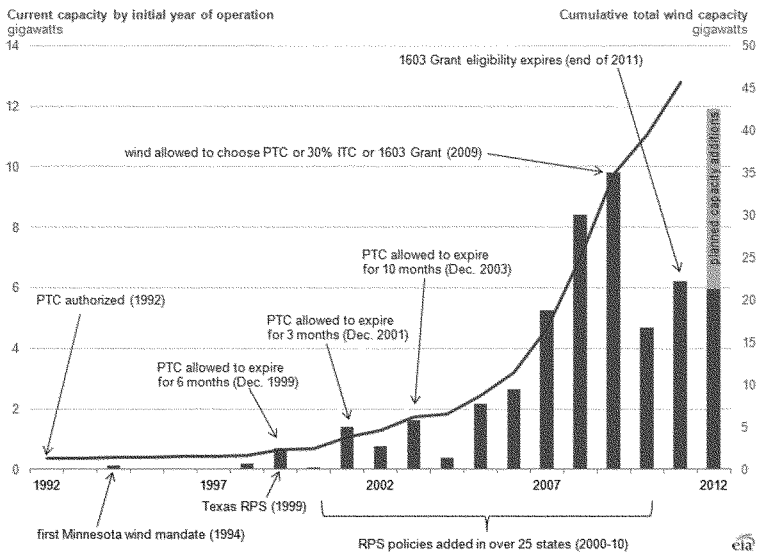
Carbon reduction benefits: If this wind power displaced power generated from sources with the average California carbon intensity, it would result in about 18 million fewer tons of carbon dioxide emissions through 2033. Carbon reductions would have to be valued at nearly $130 per ton carbon dioxide for the climate benefits to equal the subsidies (more than 6 times the primary estimate used by the government in evaluating rules).

In regard to the Shepherds Flat project, taxpayers were expected to fund by far the largest share of the bills and the risk and in return they were getting only miniscule benefits in terms of reduced greenhouse gases. In contrast, the corporations behind the project, who were not taking much of the risk, stood to profit handsomely. Despite understanding that a loan guarantee for the Shepherds Flat project was unnecessary, the administration approved the loan guarantee anyway.

The American Taxpayer Relief Act of 2012

The American Taxpayer Relief Act of 2012 extended a number of energy tax incentives through December 31, 2013, costing the taxpayer over $18 billion.[xxii] The most publicized and costly is the production tax credit (PTC) for wind garnering a 'one-year' extension that will cost taxpayers over $12 billion over a ten year period. This tax credit for wind has been in effect off and on for 20 years without accomplishing its job, which is to make this industry competitive on its own.[xxiii] The credit provides 2.2 cents per kilowatt hour for electricity generated for the first 10 years of operation of the wind unit. While the original PTC stipulated that the wind unit must begin operation in the year of the credit, the extension that was passed only indicates that the project must begin construction in the initial year and that the unit has 2 more years to become operational.

Unfortunately for taxpayers, the expense of the PTC was not needed since another policy (the Renewable Portfolio Standard) implemented by over half our states is driving most of the wind capacity additions.[xxiv] As the graph below shows, the PTC was first passed in 1992, but it did little to generate interest in the wind industry in the 1990s. Once Texas introduced its RPS in 1999 under then-Governor George W. Bush, mandating a specific percentage of its electricity be produced by qualified renewable technologies, and most other states followed with their RPS programs between 2004 and 2007, wind construction began to take off.



Further the PTC is designed inappropriately, providing the wrong incentives for wind to truly be competitive in the long run. The PTC, as its name states, awards a subsidy for each kilowatt hour of electricity produced. The problem is that the production of electricity is much more valuable when demand is high during the day, rather than when demand is low during the night and early morning hours. The PTC, however, awards the same subsidy for production anytime. Unfortunately, wind generally blows the strongest when electricity is worth the least. Thus, the PTC not only provides the wrong incentives, but it disrupts the electricity grid. Wind operators are willing to bid negative prices in order to receive the PTC, forcing other technologies that are built to run continuously to stop production or pay penalties.

Because wind does not blow all the time, it must have back-up power, typically coal-fired or natural gas-fired power plants that can provide power when demanded. That means that we are essentially paying twice for new generating capacity, i.e. the wind turbines that generate the wind power and the natural gas- or coal-fired power that provides the back-up electricity when the wind isn't blowing. The Electric Reliability Council of Texas, for example, in its planning assumes that only 8.7 percent of its wind capacity can be relied on to supply electric capacity when needed. The distinction is that wind supplies generation, but not dependable generating capacity. This is akin to a government policy that forces Americans to buy an additional car that runs only some of the time with all its expenses, when all the family needs is one car that operates all the time.

Other energy tax incentives extended through December 31, 2013, by the American Taxpayer Relief Act and their cost to the taxpayer through FY 2022 are[xxv]:

- Credit for energy-efficient existing homes ($2,446 million).
- Credit for alternative fuel vehicle refueling property ($44 million).
- Credit for 2- or 3-wheeled plug-in electric vehicles ($7 million).
- Cellulosic biofuel producer credit ($50 million).
- Incentives for biodiesel and renewable diesel ($2,181 million).
- Production credit for Indian coal facilities placed in service before 2009 ($1 million).
- Credit for energy-efficient new homes ($154 million).
- Credit for energy-efficient appliances ($650 million).
- Special allowance for cellulosic biofuel plant property ($2 million through FY 2014).
- Special rule for sales or dispositions to implement FERC or State electric restructuring policy for qualified electric utilities ($315 million through FY 2017).
- Alternative fuels excise tax credits ($360 million).

Issues with Government Subsidies

Subsidies have ramifications in the economy. One of which is that the money to provide the subsidies is money that is taken from taxpayers. This means that taxpayers have less money to spend and this destroys jobs elsewhere. Subsidies don't create jobs—they shift jobs from one sector of the economy to another. A study analyzing Spain's experience with renewable energy and job shifting found that for every renewable job, 2.2 jobs were lost elsewhere in the economy.[xxvi] Spain is now experiencing the exodus of its renewable energy industries because its financially strapped government and 20+ percent unemployment means neither the government nor consumers can afford to pay for the more expensive energy renewable sources provide.[xxvii] The electricity system deficit due to the higher cost of electricity in Spain is over 24 billion Euros (over $30 billion) and that amount is growing.[xxviii] Further, the Spanish government is now being faced with international legal action from its foreign investors in renewable energy projects who allege that the new rules that remove subsidies and levy taxes on all energy forms break their contracts.[xxix] And Spain is not alone, as other countries including Germany, Greece, France and the United Kingdom are dropping or reducing subsidies for "green energy."[xxx]

Subsidies also create industry dependence on the government because they remove the incentive for companies to make their technologies cost-competitive from the onset. Without the subsidy, companies can determine at what price the technology would enter the market place and work towards the economics to achieve it. According to the Energy Information Administration, without subsidies, the cost of new onshore wind generation on a kilowatt-hour basis is estimated to be 32 percent higher than new natural gas combined cycle generation and solar photovoltaic generation is 120 percent more expensive than generation from that same gas-fired technology.[xxxi] And, these costs exclude hidden costs of

these renewable technologies such as the cost of the back-up power required to keep consumers' energy demand met continuously since electricity cannot be stored as fossil fuels can.[xxxii] For decades, representatives and advocates of wind and solar have claimed that their technology was near a competitive tipping point—but just needed a bit more subsidies, set-asides, and government aid to succeed. But even after decades of massive subsidies, wind and solar continue to be more expensive and contribute only a small amount of electricity.

Subsidies also tend to offset financing from the private sector—a sector that has a much better track record for picking winners and losers than does the government. Often, subsidies provide financing to companies that would have undertaken the investment without the subsidy support.

Further, if the project is a winner, subsidies waste taxpayers' money by funding projects that the private sector should fund and would fund if the project were economic, thereby offsetting part of the projects' cost with government funds. And, if the project is a loser, the government is directly wasting taxpayers' money by subsidizing it, such as the case with Solyndra. Because investors have more expertise, knowledge, and "skin in the game" than government bureaucrats in making these decisions, they, rather than the government, should be making them.

For example, the massive amount of subsidies in ARRA failed to anticipate, predict, or even help the most important technological advancements and biggest change in energy production in the last couple decades -- hydraulic fracturing coupled with directional drilling. Hydraulic fracturing is a completely market driven technology that has not been subsidized by the government. The hydraulic fracturing revolution shows why the market is superior to government subsidies in selecting winning technologies. Funded entirely by the private sector, it has dramatically lowered natural gas prices, increased oil production on non-federal lands at the fastest rate since 1859, created jobs, and led to real benefits for Americans, which is not the case for most government subsidies.

Subsidies also promote crony capitalism by encouraging industries that benefit to spend more money lobbying for government handouts from politicians and bureaucrats. If a company's business model requires a guaranteed subsidy from the government, the company will dedicate whatever resources are necessary to ensure that such subsidies continue. For example, industries that benefit from subsidies will spend more money lobbying for continued government handouts.[xxxiii] Clearly, the American Wind Energy Association and the Renewable Fuels Association have continued to lobby for renewable subsidy extensions and mandates when they have already received them for decades without making their technologies cost-competitive.

Conclusion

From the EIA study, we see that those energy fuels/technologies receiving the largest subsidies are producing the least amount of energy for the nation. And those technologies, some of which have been subsidized for decades, are still a long way from being cost-competitive given the lobbying that their industry associations are doing to continue their subsidization.

Clearly, there are issues with subsidies. The shifting of jobs from one economic sector to another because of subsidization can actually result in more job losses than gains as can be seen from Spain's experience. Furthermore, governments historically do not have a good track record for determining winners and losers, which is exemplified through DOE's loan guarantees to companies like Solyndra. Numerous companies went bankrupt despite free or easy money either because their technologies were too complicated, too expensive, or markets were insufficient to support their products.

Wise investments would most likely have been undertaken anyway even without the expenditure of government funds. After all, energy is the largest business in the world and whoever provides an economically-winning source of energy stands to benefit handsomely.

Thank you for the opportunity to supply this testimony for the Committee's use.

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[i] Energy Information Administration, *Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2010*, July 2011, http://www.eia.gov/analysis/requests/subsidy/pdf/subsidy.pdf

[ii] Congressional Budget Office, Federal Financial Support for the Development and Production of Fuels and Energy Technologies, March 2012, http://www.cbo.gov/sites/default/files/cbofiles/attachments/03-06-FuelsandEnergy_Brief.pdf#page=3

[iii] CNN Money, What we got for $50 billion in 'green' stimulus, October 3, 2012,http://money.cnn.com/2012/10/03/news/economy/green-stimulus/index.html

[iv] Recovery.gov, Track the Money, http://www.recovery.gov/Pages/default.aspx

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Mary J. Hutzler
Distinguished Senior Fellow

Mary J. Hutzler is a Senior Fellow at IER. Until she left Government in 2006, she was a top energy analyst for the U.S. Government, having spent more than 25 years at the Energy Information Administration (EIA), where she specialized in data collection, analysis, and forecasting.

Beginning in 2004, Hutzler worked as the Associate Director of Statistical Programs at the Bureau of Transportation Statistics (BTS), serving 14 months as the Associate Director and 6 months as the Acting Director of BTS. In the latter job, Hutzler ran the bureau's daily operations, briefed Administration officials and Congressional staff, and managed BTS's data and analysis programs. As Associate Director, Hutzler managed large-scale freight and travel surveys and all analytical research, including new statistical methods and estimation of transportation data.

In 2001, Hutzler was named by President Bush to lead the EIA as Acting Administrator. In this role, she testified before Congressional committees, briefed policymakers on energy issues, held press conferences on EIA products, and interacted with energy organizations on controversial issues dealing with EIA data collections. In recognition of her achievements, Hutzler received a 2004 Presidential Rank Award, an honor by which the president "recognizes and celebrates a small group of career senior executives."

Before and after her stint as the acting administrator and deputy administrator of EIA, which lasted from June 2001 to March 2003, Hutzler was director of the EIA's Office of Integrated Analysis and Forecasting. As such, she planned, directed, and managed all mid- and long-term analysis and forecasting at EIA, as well as the production of EIA's annual forecasting publications. Hutzler oversaw development of the National Energy Modeling System, for which she received a Presidential Rank Award in 1999. She also produced numerous studies for both Congress and the Administration on various key topics, such as the Kyoto Protocol, low-sulfur diesel rules, the depletion of oil and gas reserves, and Renewable Portfolio Standards.

Hutzler received her B.A. in mathematics from Adelphi University, her M.A. in applied mathematics from the University of Maryland, and completed her course work and exams for a D.Sc. in operations research at George Washington University.

Chairwoman LUMMIS. Thank you, Ms. Hutzler.
I now recognize Mr. Woolf to present his testimony. Welcome.

STATEMENT OF MR. MALCOLM WOOLF,
SENIOR VICE PRESIDENT,
POLICY & GOVERNMENT AFFAIRS,
ADVANCED ENERGY ECONOMY

Mr. WOOLF. Thank you, Chairman Lummis, Ranking Member Swalwell, and Subcommittee Members. I appreciate the opportunity to testify today.

My name is Malcolm Woolf. I am the Senior Vice President of the Advanced Energy Economy. AEE is a national network of business leaders whose companies are making the global energy system more secure, clean, and affordable. My testimony today will focus on two things: first, that new energy technologies face a series of structural market barriers to entry that have often required federal support to overcome; and secondly, that Congress should consider a core set of principles reorienting federal financial support to more effectively encourage private sector innovation.

Let me begin by explaining what I mean by advanced energy. AEE defines advanced energy broadly to include the best available commercial technologies, such as energy efficiency, appliances, advanced gas turbines, nuclear power renewable technology, alternative vehicles. The business opportunity for advanced energy, broadly defined, is huge and growing. A recent report commissioned by our sister organization, the Advanced Energy Economy Institute, documented that the global advanced energy industry was a $1.1 trillion dollar industry today. In the United States alone, the advanced energy market was $132 billion dollars in 2011. So this is a big industry today. It is larger than the trucking history.

Since this hearing is focused on federal financial support for energy technologies, it is appropriate to ask the question, why is federal support even needed? My answer is simple. Energy technologies face a series of structural barriers to entry that hinder innovation in the energy markets. Let me highlight three examples of these structural barriers.

First, the market fails to appropriately reward innovations that don't directly affect price. Externalities like grid reliability, resiliency, energy security, public health—all of those externalities are hard to put into the price of electricity, so the market systematically undervalues them.

Secondly, the legal framework for electric and natural gas utilities, as well as their long-lived assets, discourages innovation in their sector. Why should a utility take a risk on investing in unproven innovative technology that regulators may not deem worthy of reimbursement when they get the exact same rate of return if they invest in well-established existing technologies?

Finally, the Federal Government needs to compensate for the chronically low level of private sector energy R&D. The energy sector historically invests less than one percent of revenues in R&D. In contrast, innovative-intensive industries like telecommunications routinely invest over 10 or 20 percent. The Federal Govern-

ment needs to continue to support the development of energy technology, but the Advanced Energy Economy recognizes the Nation's fiscal realities. To more effectively use taxpayer dollars, AEE suggests a fresh approach whereby we refocus federal financial outlays on a core public purpose: promoting innovation to give the United States energy that is secure, clean, and affordable.

Let me offer for your consideration the following four principles:

First, be targeted. Rather than providing permanent support to mature technologies that already have significant market penetration, the Federal Government should focus its resources on driving innovation to develop, demonstrate, and deploy the next generation of technologies.

Secondly, we should sunset or automatically revise provisions when the market-based objectives have been reached. No company or technology should be entitled to a permanent subsidy. Incentives should remain in place only long enough to achieve a measurable market-based goal.

Third, provide stability and certainty for investors and businesses. Clear roles tying federal support to market-based metrics rather than a calendar of political deadlines would allow the market to drive success.

Fourth and finally, we need to be technology neutral to support all forms of advanced energy. Many of today's energy policies were written by Congress with one sector or technology in mind. Federal support needs to be applied broadly as reasonable to stimulate innovation across all sectors.

In closing, the four principles I articulated represent a common sense approach that would reorient federal financial support to more effectively spur innovation. At the same time, they represent a significant break from the status quo. I look forward to working with the Committee to reform federal energy tax policy around these core principles to drive a more secure, clean, and affordable energy future.

Thank you.

[The prepared statement of Mr. Woolf follows:]

ADVANCED ENERGY ECONOMY
The business voice of advanced energy

Malcolm D. Woolf
Senior Vice President, Policy and Government Affairs
Advanced Energy Economy

"Federal Financial Support for Energy Technologies: Assessing Costs and Benefits"

Testimony before the U.S. House of Representatives
Subcommittee on Energy
Science, Space, and Technology Committee

March 15, 2013

Chairwoman Lummis, Ranking Member Swalwell, and Subcommittee Members, thank you for affording me the opportunity to testify today.

My name is Malcolm Woolf, and I am the senior vice president for policy and government affairs of the Advanced Energy Economy (AEE). AEE is a national association of business leaders who are making the global energy system more secure, clean, and affordable. Just as the Internet economy transformed society in ways we did not expect, the advanced energy economy is creating dramatic new opportunities for economic growth in the United States and around the world.

AEE's mission is to influence public policy, foster advanced energy innovation and business growth, and provide a unified voice for a strong U.S. advanced energy industry. Founded in 2011, AEE has a national network of business members across states and across industries to help the advanced energy industry succeed. In addition, AEE has partner organizations in Arkansas, Colorado, Illinois, Michigan, North Carolina, New Mexico, Nevada, Ohio, South Carolina and New England, with more to come, as well as active engagements in California, New York and Maryland.

I commend the Subcommittee for convening this hearing on *"Federal Financial Support for Energy Technologies: Assessing Costs and Benefits."* With global energy consumption projected to rise nearly 40 percent by 2030, future prosperity depends on meeting growing demand with energy that is secure, clean and affordable.

After briefly addressing the significant opportunities for U.S. businesses in advanced energy, my testimony today will focus on two important themes:

1) New energy technologies face a series of structural market barriers to entry that often have required federal financial support to overcome; and

2) Congress should utilize a core set of principles that we have developed to reorient federal financial support to more effectively encourage private sector innovation in technologies that promote a secure, clean and affordable energy future.

What Are the Advanced Energy Opportunities for U.S. Businesses?

Advanced energy encompasses a broad range of products and services that constitute the best available technologies for meeting energy needs today and tomorrow. It includes such diverse technologies as energy efficient appliances, renewable energy systems, nuclear power, advanced gas turbines, hybrid vehicles, and information technology as applied to the energy industry. Advanced energy is dynamic, as innovation and competition produce better energy technologies, products and services over time.

The business opportunity in advanced energy for U.S. companies is large and growing, both at home and globally. A recent report, commissioned by our partner educational organization, the Advanced Energy Economy Institute, documented that the global advanced energy industry is larger, by revenue, than pharmaceutical manufacturing, and roughly two-thirds the size of telecommunications. In the United States, advanced energy is larger than the trucking industry and more than twice the size of the commercial casino industry.

The key findings of this first-of-its-kind study include:

- In 2011, global revenue from the seven advanced energy segments reached nearly $1.12 trillion.
- The U.S. advanced energy market reached $132 billion in 2011, representing nearly 12% of the global market.
- Based on information available in late 2012, the U.S. advanced energy market was expected to grow to an estimated $157 billion in 2012, with the U.S. share of the global market expected to rise to 15%.
- The U.S. advanced energy market contributed $13.9 billion in federal tax revenue in 2011, plus another $6.7 billion in state and local tax revenue, for a total tax contribution of $20.6 billion.

Are There Structural Barriers That Necessitate the Government Playing a Role in the Development of New Energy Technologies, Products and Services?

As AEE's member companies can attest, new energy technologies face a series of structural market barriers to entry. As such, the federal government needs to continue to play a vital role in supporting new energy technologies, products and services. AEE notes, however, that the federal government's engagement in technology development should be limited to those situations where there are public benefits that the private sector does not capture.

Let me highlight a few of the most significant structural barriers that hinder innovation in the energy markets.

First, the market fails to appropriately reward innovations that do not directly affect price. There are a wide range of important externalities in energy, such as grid reliability and resiliency, energy security, safety, fuel diversity, and public health impacts. Since these externalities are difficult to monetize and reflect in the price of energy, the market systematically undervalues them. For example, the free market may not appropriately value a new technology that is more expensive but makes the system less vulnerable to a cyber attack.

Second, the legal framework of electric and natural gas utilities, along with their long-lived assets, discourages investments in innovation. Since the early days of electrification, electric and natural gas utilities have received a guaranteed rate of return as long as their investments were prudent. While this is a sound public policy for keeping the lights on, it creates a powerful disincentive for utilities to innovate. After all, why should they take a risk on unproven, innovative technology that regulators may not deem worthy of reimbursement when they would receive the same rate of return by using established, existing technologies? When coupled with the institutional inertia that comes from having billions invested in long-lived assets, new technologies and services have an extremely high barrier to entry.

Finally, the federal government needs to compensate for the chronically low level of private sector energy research, demonstration and deployment. According to a 2010 report, "U.S. energy firms reinvest well below one percent of their revenues in R&D, with much of that amount chiefly spent on improving current technologies instead of developing new ones."[2] The chronically

[2] *"Post-Partisan Power: How a Limited and Direct Approach to Energy Innovation can deliver Clean, Cheap Energy, Economic Productivity and National Prosperity,"* S. Hayward, American Enterprise Institute, M. Muro, Brookings Institute, and T. Nordhaus and M. Shellenberger, Breakthough Institute, October 2010, at p. 13.

low level of private sector investment isn't surprising in light of the high barriers to entry already discussed. In contrast, innovation-intensive industries like telecommunications, semiconductors and pharmaceuticals invest 10-20% of their revenues in research and new product development.

Other significant market barriers beyond the initial higher price of new energy technologies include the capital-intensive nature of energy technologies, the inherent technology and policy risks in energy markets, the long time horizon of many advanced energy projects, and a lack of wide-spread enabling infrastructure to support advanced energy technology deployment, such as electric transmission capacity or alternative energy fueling stations.

When Has Federal Support Been Successful in Encouraging Innovation and Helping Businesses Overcome These Market Barriers?

Different forms of government support and tools are needed to help overcome different market hurdles. Let me offer a few examples of how federal financial support has been critical in accelerating innovation in the energy sector:

- Renewable electricity generation benefits from a fuel source that is free (e.g., wind, solar, geothermal), yet needs to overcome high upfront capital costs. This barrier is reduced if the industry can build sufficient economies of scale, which is why federal tax credits have generally proven to be effective. Federal tax credits stimulate a national market of sufficient size and stability to spur innovation and support domestic manufacturing capacity, which has helped to dramatically reduce the levelized energy production cost over the last decade.

  In 2012, wind energy for the first time became the number one source of new U.S. electric generating capacity, providing 42 percent of all new generating capacity. Similarly, the price of PV cells has fallen from over $76 dollars a watt in 1977 to about 75 cents a watt in 2013, with many technological developments yet to move from the laboratory to the factory.[4] Both land-based wind and solar PV are becoming increasingly cost competitive and have actually reached "grid price parity" in certain local markets.

- The private sector typically does not invest heavily in energy research and development because they cannot easily capture the "spillover" benefits that result. For this reason, DOE supported research on shale gas going back to

[4] *"Alternative Energy Will No Longer Be Alternative,"* The Economist, Nov. 21, 2012, available at http://www.economist.com/blogs/graphicdetail/2012/12/daily-chart-19

1976, including assessments of the resource base, experiments in directional drilling and hydraulic fracturing techniques. As a result of this research and a series of public-private collaborations, America is now reaping the benefits of the current natural gas production boom.

- To help drive innovation in energy efficient lighting, DOE created the L-prize in 2008, a government-sponsored technology competition designed to spur lighting manufacturers to develop high-quality, high-efficiency products to replace the common light bulb. The winner was the Philips AmbientLED. If these bulbs were widely used across the country, the nation would save about 35 terawatt-hours of electricity or $3.9 billion in one year. That's enough electricity to power the lights of nearly 18 million U.S. households, or nearly triple the annual electricity consumption in Washington, D.C.

Most major energy technologies over the last half-century have benefited from a federal role in its research, demonstration and/or deployment, including most fossil fuels, renewables and energy efficiency technologies. In the landmark National Academy evaluation of DOE R&D from 1978-2000, Congress asked the Academy: "Was it worth it?" The resulting study found that the $15 billion spent on energy efficiency and fossil fuel R&D over a 22-year period yielded a "realized benefit" of about $41 billion, in addition to the "options benefits" and "knowledge benefits".[5] The technologies evaluated included building and industrial efficiency technologies, such as low-e glass, electronic ballasts for fluorescent lighting, compact fluorescents, oxygen-fueled glass furnaces, and the development of more efficient gas turbines through the Advanced Turbine Systems program. The $41 billion in benefits did not include the environmental benefits conservatively estimated as ranging from $60-90 billion over the 22 year period.

What are the Core Principles that Should Guide Federal Support for Innovation in Energy Technologies, Products and Services?

AEE believes there are significant opportunities to better utilize taxpayer dollars and, at the same time, more effectively promote secure, clean and affordable energy.

The ongoing conversations about fiscal reform provide an immediate opportunity to help build a better paradigm for the advancement of energy technology by applying business-focused principles to R&D investments. Rather than engage in a political food fight, where only those provisions supported by the strongest special

[5] *"Energy Research at DOE: Was It Worth It?,"* Energy Efficiency and Fossil Energy Research 1978 to 2000, Committee on Benefits of DOE R&D on Energy Efficiency and Fossil Energy, Commission on Engineering and Technical Systems, National Research Council, (Free Executive Summary at http://www.nap.edu/catalog/10165.html)

interest can survive, AEE suggests a fresh approach whereby we refocus the federal energy outlays on a core public purpose – promoting innovation to give the United States energy that is secure, clean and affordable.

Over the decades, federal expenditures on energy, from the tax code to loan programs, have become a complicated patchwork of technology-specific benefits, with the size and scope of dollar flows differing greatly even between technologies that compete in the same markets. A lack of consistent, core principles underlying the use of federal funds in energy technology limits the effectiveness of those investments.

Through a series of conversations and interactions with numerous stakeholders, AEE has created a set of core principles that can act as a guide to federal expenditures in the development of energy technologies, products and services:

1 - **Be targeted: limit federal funds to where innovation is needed to build a more secure, clean and affordable energy future**. Federal energy programs should only be provided where there is an essential public purpose. Rather than providing permanent support to mature technologies that already have significant market penetration, the federal government's role should be limited to driving innovation and commercializing the next generation of technologies, products and services that promise public benefits. These public benefits include enhancing energy security through fuel diversity and grid modernization, providing cleaner energy that better protects public health, reducing energy costs for consumers and businesses, and developing products that can be competitive in world markets.

2 - **Sunset or automatically update provisions when market-based objectives are achieved**. No company or technology should be entitled to permanent subsidies or investments. For example, when left in place too long, tax incentives distort price and market signals and ultimately create barriers to entry for new technologies. Therefore, such incentives should remain in place only long enough to achieve a measurable, market-based objective (for example, gigawatts installed or share of market) that represents a point at which emerging technologies have reached sufficient maturity that they should stand on their own. Each provision should have an automatic phase-out or periodic update built in from the beginning to send clear signals to businesses and investors.

3 - **Provide stability and certainty for businesses and investors**. Businesses and investors need certainty to make the investments and set the plans necessary to grow. Rules that change frequently or unpredictably are disruptive to markets and harmful to the businesses, investors, and consumers participating in them. Using meaningful, performance metrics tied to maturity in the marketplace, rather than calendar deadlines, to sunset a program or automatically update federal

standards would provide certainty to investors, focus businesses on bringing their technologies to scale and moving down the cost curve, and allow market dynamics to drive business success.

4 - **Be technology neutral to support all forms of advanced technology.** Many of today's energy policies were written by Congress with one sector in mind, even favoring a single technology. Such an approach distorts market signals and puts the weight of Congress behind investment decisions. This is inefficient and imposes unnecessary risk to taxpayers. In addition, this approach can inadvertently freeze out next-generation technologies since the best available technology today will not necessarily be the best in the future. Energy R&D programs play an especially critical role in driving the development of next generation technologies. Such programs should be applied as broadly as reasonable to stimulate innovation across technologies, including those that have not yet emerged.

A New Approach to Energy Policy

In closing, AEE believes that the federal government needs to continue playing a vital role in helping energy technologies overcome multiple structural barriers. I believe that the four principles I articulated represent a common sense approach that would reorient federal energy financial support to more effectively spur innovation. At the same time, these principles represent a dramatic break from the status quo. I look forward to working with the Committee to reform federal energy policy to drive a more secure, clean and affordable energy future.

Thank you. I am happy to answer any questions.

Malcolm D. Woolf
Senior Vice-President, Policy & Government Affairs
Advanced Energy Economy

Malcolm Woolf joined the Advanced Energy Economy (AEE) in September 2012. As senior vice president of policy and government affairs, Malcolm works to influence public policy, foster advanced energy innovation and business growth, and provide a unified voice for all segments of the advanced energy industry.

Before joined AEE, Malcolm served as a Cabinet-level official with Governor Martin O'Malley. As head of the Maryland Energy Administration from 2007-2012, he helped enact and implement one of the most ambitious sets of energy goals in the nation, including the EmPOWER Maryland Act seeking a 15% reduction in peak demand and overall electricity consumption, a 20% renewable standard, and a 25% reduction in greenhouse gas emissions. To achieve these goals, MEA launched numerous innovative new programs to promote greater use of advanced energy technologies. Several of these programs have received national recognition, including the Generating Clean Horizons program that was named one of the "top 25 innovations in American government" by Harvard University's John F Kennedy School.

An energy expert with experience at the national level and in the private sector, Woolf was the chair of the National Association of State Energy Officials (NASEO), has testified before Congress on several occasions, and is frequently featured in national media. He was recently appointed by Secretary Chu to serve on the U.S. Department of Energy's State Energy Advisory Board.

Woolf has extensive energy experience both within federal and state government, as well as private legal practice. Woolf previously served as the director of the National Governors Association's Natural Resources Committee and counsel to the U.S. Senate Environment and Public Works Committee. He also was a senior attorney with the U.S. Environmental Protection Agency, and an associate with the law firms of Winston & Strawn and Piper & Marbury L.L.P.

Woolf received his B.A. magna cum laude from Tufts University, with a year abroad at Pembroke College, Oxford University. He earned his law degree, as well as a Masters of Public Administration and Public Policy, from the University of Virginia.

Chairwoman LUMMIS. I would like to thank all of our witnesses for being available today and again for your patience with the delayed start of this hearing. The Committee rules limit questioning to five-minute rounds.

And we have two Members of this Committee who have conflicting committee assignments, so we will be going first to Mr. Hultgren of Illinois, and he will be followed by Mr. Kennedy of Massachusetts. So the Chairman of our Full Committee and the Ranking Member of this Committee have graciously offered to defer their questions until later.

So at this time, I will recognize the gentleman from Illinois, Mr. Hultgren, for five minutes.

Mr. HULTGREN. Thank you, Chairwoman Lummis.

Thank you so much for being here today. This is obviously a very important subject during these difficult budget times.

I want to talk today about priorities. When resources are limited, priorities are more important than ever. We have heard over and over again from this Administration that there isn't enough money to invest in basic research as they cut high-energy physics, they cut nuclear physics, they cut manned space exploration. President Obama shut down the Tevatron in Illinois, he canceled the Constellation Program that would restore American preeminence in space, and he shifted the focus of agency missions away from the pure scientific route to instead follow the path of what is politically expedient for him and his base. These are truly painful cuts to long-term American competitiveness and innovation.

I have here in my hand a letter to our Governor in Illinois from the Deputy Secretary of Energy warning about pending cuts and furloughs as a result of the sequester. In the letter, President Obama's Administration threatens about 1,750 furloughs at Fermilab in my district over the sequester, which is ironic considering that the sequester would actually be a higher level of funding than President Obama's own budget proposal for Fermilab. The President wants to see a cut to the lab of almost double what the sequester is going to cut. Meanwhile, the President has shown no hesitation to squander tens of billions of dollars on tax incentives, loan guarantees, and directing spending on development and commercialization activities. This, to me, is a staggering level of hypocrisy.

Ms. Hutzler, I wonder; you are a trained scientist, you have got an advanced degree in applied mathematics. Would you characterize President Obama's shifting of funding from basic research to subsidies for the alternative energy industry as pro-science?

Ms. HUTZLER. No, I wouldn't because there—I mean picking winners and losers by dealing with these subsidies has not been a good thing of the government in the past. We have—throughout history, we have seen that the government isn't good at picking winners and losers. So there are better ways of spending the money. And their—you could always put up Washington monuments if you want, but you can also figure out other ways to cut your budget.

Mr. HULTGREN. Ms. Hutzler, your testimony highlights the enormous growth in spending on energy technologies from 2007 until 2012. Please describe the corresponding growth in energy production during this time. Just as a follow-up, DOE figures show that

solar and wind generation contributed a minimal share of current electricity generation. Do you consider the significant increase in subsidies to have been effective in their oft-stated goal of transforming the Nation's electricity portfolio?

Ms. HUTZLER. No, I don't. Renewables did increase their share, but as I mentioned in my testimony, that hydropower actually contributes the most in terms of the renewable share. So while renewables did increase their share, most of the change that has occurred has been between coal and natural gas, where they have sort of flip-flopped in terms of their share in the generating sector.

I did look at how much increase we got from renewables in that five-year period in terms of BTUs. We increased non-hydro-renewables by about two quadrillion BTUs, but in fact, we increased oil and gas by 5.3 quadrillion BTUs. So that is more than double when they have gotten a much smaller share of the subsidies.

Mr. HULTGREN. Yes, and the DOE figures I saw were that wind is about three percent, solar is less than one percent of current electricity generation. Well, this is an important topic. I know we are running late so I am going to yield back the rest of my time and thank the Chairwoman and also think the Chairman and the Ranking Member for allowing me to go ahead of schedule. So thank you so much.

I yield back.

Chairwoman LUMMIS. I thank the gentleman from Illinois and would recognize the gentleman from Massachusetts, Mr. Kennedy, for five minutes.

Mr. KENNEDY. Thank you, Madam Chair. Thank you to the Ranking Member, to the Chairman as well, and to the witnesses here for coming to testify today. Thank you for your time and your knowledge.

I have got a question, just to begin, to Mr. Woolf. You cite in the written testimony that you had provided that wind energy, for the first time, became the number one source of new U.S. electric generating capacity providing 42 percent of all new generating capacity. I come from a State and represent a district that has a long history of investments in innovation and has made a decision to try to be on the forefront of emerging clean energy technology, most notably wind energy in particular.

One of the questions that comes up with that is whether—is the development of offshore wind farms, both near-shore and for some further distances offshore. And I was wondering if, in your opinion, if our country actually has the expertise, the resources, and the workforce, the infrastructure to compete in that industry? And the reason why I ask is there is a local project in Massachusetts, a wind project, Cape Wind, which I am sure you are familiar with and a project that I actually support. The developer just this week indicated that he was going to be shifting some of those manufacturing jobs to an overseas manufacturer because we didn't have the capacity here in the United States to actually build the steel foundations necessary for the construction of those turbines. And I just wanted to get your opinion as to the state of the industry surrounding some of these production issues and what it would take in order to get competitive if we aren't already.

Mr. WOOLF. Thank you for your question. And I think it gets to the heart of what this Committee is looking at is what kind of energy future do we want? Where do we want to be in 30, 40 years? Because the investment decisions we are making today are going to be the plants that are operating in 30, 40 years.

As I listened to Ms. Hutzler's data, it strikes me as not at all surprising that we be investing in innovation in technologies where we don't yet have significant production, rather than the mature technologies that are already producing. I would not expect a correlation between where our investment dollars for innovation go and where the existing production goes. I think had—if this Nation begins to invest in offshore wind technologies, we would be building the supply chain for offshore wind so that we can manufacture it in the United States. I know that for land-based wind technology, 10, 20 years ago, much of it was based offshore. Now, more than 75 percent of it has become onshore, U.S. manufacturing, just like car manufacturing.

As we have built the capacity here, for the first wind project offshore, I am not at all surprised, since we are so far behind the rest of the globe, that U.S. companies are not competitive. As Cape Wind goes forward, as Governor O'Malley goes forward in Maryland, I think we will be building that U.S. capacity.

Ms. HUTZLER. I would just like to comment on the offshore wind subject. It turns out if you take a look at EIA's numbers that on a kilowatt-hour basis that offshore wind is more than 20 times the cost of onshore wind. The—in the State of Massachusetts for Cape Wind, they said that they would have to start at $.18 per kilowatt hour for Cape Wind and then increase that cost three percent a year. The average cost of electricity in this Nation is only $.10 per kilowatt hour.

You take a lot of the European countries that have offshore projects; a number of them are in fuel poverty. I think about 18 percent of the United Kingdom is in fuel poverty. And that definition is that more than 10 percent of their income is being spent on residential energy. So I think we need to take—we need to look carefully at these projects.

Mr. KENNEDY. And ma'am, your characterization of the cost of Cape Wind is obviously well known and well debated in Massachusetts. One of the issues with wind farms, as I have come to understand, anyway, is part of the upkeep and maintenance of particularly the Cape Wind project that is actually built in shallow waters is that over time, that cost comes down because you are just paying the upkeep. And in fact, the wind is free.

So I appreciate it and I yield back the balance of my time.

Ms. HUTZLER. But I think there is an issue here, too, that we are not that familiar with the maintenance cost to really know that. I mean those are pretty much guesses, and once we—once the technology has been around even in European countries, we will find out more about it.

Mr. KENNEDY. And Mr. Woolf, would you like to comment on that?

Mr. WOOLF. Sure. Offshore wind has been used in Europe for many decades now, so I think we have got a pretty good sense of what it takes.

Mr. KENNEDY. Yeah, my five seconds. Thank you, Madam Chair.

Chairwoman LUMMIS. Thank you, Mr. Kennedy.

And now the Chairman will yield five minutes to herself.

My first question is for Dr. Dinan, and it is about eligibility to qualify for the Wind Production Tax Credit. Now, in the fiscal cliff deal, there was an extension and modification of the Production Tax Credit for one year, even though it was supposed to expire at the end of 2012. So it provides that any project is eligible that begins construction. That is the operative language I am curious about. The modification makes eligible any project that begins construction by December 31, 2013. The IRS has not yet issued guidance as to the definition of "begin construction." But based on precedent, projects have expended only five percent of the project costs and yet may qualify. So my question is this: how does the broad definition of "beginning construction" impact the estimated costs of the Production Tax Credit?

Dr. DINAN. Your description of the extension of the Production Tax Credit is correct. They now qualify based on beginning construction. However, CBO does not estimate the cost of that extension, and that would be the Joint Committee on Taxation. So it is nothing I can comment on.

Chairwoman LUMMIS. If the IRS determines how it is going to define "begins construction," will CBO then be able to update the estimates?

Dr. DINAN. No, because CBO estimates the budgetary cost of legislation that involves spending, but revenue—the effects of changes in revenue are made by—those cost estimates are made by the Joint Committee on Taxation, not by the Congressional Budget Office.

Chairwoman LUMMIS. And will the Joint Committee on Taxation update it?

Dr. DINAN. Yes, they each year estimate the cost of each individual provision. And so——

Chairwoman LUMMIS. Thank you. Second question, and I also want to ask this of Dr. Dinan and Ms. Hutzler. It is regarding Section 1603 grants and their ongoing funding. Now, those grants, in lieu of credits, allowed wind developers to take a cash grant instead of a tax credit. And that program expired in December 2011. But projects that had begun construction qualified, again, only five percent of capital expenditures qualified as having begun construction. And then those payments extend even after expiration. So according to CBO, even under sequestration, we plan to spend $2.6 billion on 1603 grants in FY 2013.

So, question: I was surprised to learn, Dr. Dinan, from your testimony that the Federal Government plans to give $2.6 billion of cash to wind developers this year alone through the expired Section 1603 grants. Can you explain to me why we are giving $2.6 billion for a program that expired in 2011?

Dr. DINAN. The reason for that is that the—to qualify for the 1603 grants, it is based on beginning construction prior to the expiration date. So renewable generators that were under construction prior to the December 31, 2011, qualified, but they received the actual grant at the time they begin production.

Chairwoman LUMMIS. So do you have an estimate of how much more cash we will hand out under the expired 1603 program over the next few years?

Dr. DINAN. I do not.

Chairwoman LUMMIS. Well, let me ask then, Ms. Hutzler, this: Do you think the 1603 program was good policy? How would you rank it among other maybe best-to-worst policies when it comes to subsidies or tax benefits?

Ms. HUTZLER. Well, as I indicated in my oral testimony, we believe at IER in free-market principles. So I am not sure that I would prefer any of these different types of subsidies that we are talking about. But anything where you have a policy where you can start construction but not complete it causes problems and distortions in the marketplace. So the change in the PTC is a problem because you don't know how many more years in the future you are going to have to be paying for it.

And furthermore, it is going to be hard for even the JTC to figure it out because they usually use EIA estimates on penetration. But you don't know when—somebody can start construction, but you don't know when they are going to actually start operating. They may wait until the economy is much better. So it could go many years into the future.

Chairwoman LUMMIS. I thank the witnesses and yield to the Ranking Member, Mr. Swalwell of California.

Mr. SWALWELL. Thank you, Chairman Lummis. And I am actually going to yield and ask to come back after Mr. Veasey and your next Member goes.

Chairwoman LUMMIS. I yield than five minutes to Mr. Veasey.

Mr. VEASEY. Madam Chair, thank you very much. And I wanted to ask Ms. Hutzler and Mr. Woolf just some questions about intangible drilling costs and depletion write-offs and things like that versus the subsidies because, you know, you hear a lot about we are picking winners and losers, but where do those things in the traditional fossil fuels sector—how do they pair up with what is going on as far as wind is concerned?

Ms. HUTZLER. The—well, the issues that you are talking about here are the percentage allowance depletion and the intangible drilling costs. Both of these are tax deductions. And they mostly affect the small, independent producers. These are producers that are producing from marginal wells. And these deductions are helping them in terms of depreciation, in terms of depletion allowance, and in terms of essentially R&D to be able to get to the oil or gas out in the marginal wells.

A good portion of our oil and gas production comes from the independents, so we are trying to support this particular entity in terms of tax deductions. But these are similar deductions that other businesses and manufacturing companies are getting in terms of depreciation and in terms of research and development. They are not individual things such as the Production Tax Credit that one gets.

Mr. WOOLF. Excuse me. From the Advanced Energy Economy's perspective, we wouldn't look at it as a credit for one subsidy or one technology versus another technology. What we are urging Congress to consider is a principled approach whereby we look at—

the first question is, is innovation needed, or is this a mature technology that no longer needs innovation? But if it is a technology where we want the country to go, where innovation is needed, then the second question is, what is the market-based goal? Once you establish that market-based goal, you know what you are shooting for. You have a vision for the future and then it can automatically sunset when you reach that goal.

I would apply that standard to all technologies, whether it is the existing permit and credits that the oil and gas industry enjoyed or the one-year extensions that the wind guys have to fight for every year. I think we should have a neutral approach for all technologies, think about what is our goal, and is this an innovation area that we should be investing in?

Mr. VEASEY. Right. Exactly. And, you know, I guess my thought—and I would certainly like to hear from you on this—is that, you know, we talk a lot about being independent from, you know, and being able to produce our own energy and trying to lessen our dependency on foreign oil. It would just seem like, you know, that an investment in wind and in other things, I guess the technology that is driving a lot of the development, particularly in Texas where I am from, I know that many of the independents—when the big companies left those fields and the independents came back again, it was because of the technology that they used to bring us to the level where we are at now to where, you know, now, we are much higher up on the scale as far as, you know, producing oil. So does that make sense—I guess, really to you, Ms. Hutzler, to invest in both of those so we can be more independent as a country?

Ms. HUTZLER. I think it deals with how competitive these technologies are. If you take onshore wind, it is 30 percent more expensive than the next—than the cheapest-generating technology, which is natural gas. And that is probably going to continue in the future, because our natural gas prices are forecasted to stay fairly low in the future. So it really depends on the competitiveness of the technology.

Mr. WOOLF. If I can respond, I would agree that in most markets, onshore wind is not cost competitive with natural gas. The conclusion, then, I draw from that is it is a sector that is ripe for innovation. Already, over the last 20 years, onshore wind turbines' cost has come down 74 percent, according to *Bloomberg New Energy Finance*. It is an area where technological advances are going very, very quickly, and that is the only way you are going to get progress. I am looking up at the quote over the Science Committee's dais here, "Where there is no vision, the people perish." If we only invest in the technologies that are currently competitive, we have no vision. We won't make progress.

Mr. VEASEY. Thank you.

Chairwoman LUMMIS. I thank the gentleman and now recognize our Vice Chairman, the gentleman from Texas, Mr. Weber.

Mr. WEBER. Thank you, Madam Chairman.

I want to take issue with something you all said earlier about investing versus subsidies. My good colleague down on the right, Mark Veasey, knows well—did I say that you are on the right, Mark? I am sorry. Down at that end of the dais. We will do that.

I don't need to out you here. He knows well that Texas is the leading wind producer in the country, and we are also poised to be the leading natural gas producer if not in the country, probably the world, hopefully.

But there is a difference, is there not—and I will address this question to Ms. Hutzler and then Mr. Woolf—in invest—when a company goes out there—and you mentioned the percentage depletion allowance specifically—and is it not true, Ms. Hutzler, that that is—and I will let you answer the question in just a minute—but that is for small companies. And was it '75 we did away with that depletion allowance for the major oil companies? These are the independent producers you mentioned. In essence, they put their money in up front. They invest capital and they take the risk. They get manpower and they get assets on the ground, and not every hole they drill is going to be productive. So they are investing their time and their energy and their resources. It makes perfect sense for me to give them a tax credit. On the other hand, to come in and give a subsidy to assist them so that they might be able to produce a product doesn't seem to make sense.

I would like to go back to something you said, Ms. Hutzler. You quoted some figures on coal subsidies, oil subsidies, and natural gas subsidies, and billions of dollars, but what I didn't hear you quote was the amount of electricity each one contributed to the Nation's grid as a result of the tax dollars spent. Do you have those figures?

Ms. HUTZLER. I think I mentioned those in my oral, and that——

Mr. WEBER. I missed those.

Ms. HUTZLER continuing]. On a per-unit-of-production basis that the subsidy for solar I mentioned was over 1,100 times more than that for oil, gas, and coal. And also for wind it was over 80 times that.

Mr. WEBER. And then it was astounding, if I recall correctly, you said the vast majority of the increase came from hydroelectric power.

Ms. HUTZLER. Of renewables, yes.

Mr. WEBER. Of renewables, right.

Ms. HUTZLER. Yes. Renewables today supply about 12 percent of our electricity, but seven percent of that is hydro.

Mr. WEBER. Right. And, to your knowledge, were we able to increase the amount of water coming downstream?

Ms. HUTZLER. The snowfall, the water changes——

Mr. WEBER. So——

Ms. HUTZLER [continuing]. 2011 was a very good year.

Mr. WEBER [continuing]. God was good to us. The best increase we got was just from the rainfall and the snow. But doesn't it seem fair to you for us to give tax subsidies to a hopefully growing technology that has been around a long time that does use windmills many, many years ago as opposed to tax credits were American entrepreneurs invest their money? Does that seem equitable to you?

Ms. HUTZLER. Well, hydro gets very little in terms of subsidies.

Mr. WEBER. Right, no, I get that.

Ms. HUTZLER. You know, right.

Mr. WEBER. The wind and solar——

Ms. HUTZLER. Right.

Mr. WEBER. Right. If we had taken the—was it $500 million that we gave to Solyndra and paid $1,000 per person on their own utility bill for a year, we could have powered the homes of half a million Americans. But anyway, does that seem fair to you, Ms. Hutzler?

Ms. HUTZLER. No, it doesn't seem fair to me.

Mr. WEBER. How about you, Mr. Woolf?

Mr. WOOLF. If I could respond to your question.

Mr. WEBER. Sure.

Mr. WOOLF. AEE supports both renewables and natural gas and, you know, all forms of advanced technologies. I think natural gas is an amazing, wonderful American success story. Because the Department of Energy invested in assessing the technology in the '70s and coming up with directional drilling techniques, you know, fracking is now bringing huge sea change to the American economy. That is a wonderful thing. That was not the case with shale gas in the 1970s. That is why we needed the federal role in investing in the innovative technologies. Now that we are there, now that we have got those technologies, it no longer needs the support.

For renewable technologies, there is a different market barrier. Their market barrier is one of economies of scale. When—and so you need—the Production Tax Credit is essential for getting them the economies of scale so they can drive down their costs and be cost effective. If you are only putting on solar or an individual windmill and you are not doing thousands and thousands of them, you don't drive down the cost; you will never be competitive.

Mr. WEBER. I want to go back to something my colleague, Mr. Kennedy, said, and that was something about the wind farm in Massachusetts, I think. And really, what we need is infrastructure, is it not? We know the technology. We need a grid. We need to be able to get—for example, in Texas, we are coming up with the wind energy to get to—our grid is the challenge. That is the bigger challenge, is it not, more so than the technology?

Mr. WOOLF. I think it is all of the above. In certain areas, certainly West Texas, the transmission congestion is a huge challenge. In other parts of the country, the Northeast, they don't have land, they don't have the resources Texas has; offshore wind is their resource.

Mr. WEBER. And I yield back. Thank you.

Chairwoman LUMMIS. I thank the gentleman and now recognize the Ranking Member of our Subcommittee, Mr. Swalwell of California.

Mr. SWALWELL. Thank you, Chair.

And Ms. Hutzler, I have to say I was disappointed in your remarks. I thought they were very politically charged. And to say that only politically connected folks are the ones that are receiving preference in our subsidies, it ignores the facts. And it also ignores the role that the States play. And individual States in our country themselves give a number of tax credits to different industries. For example, there is an oil company in Pennsylvania that, in 2012, received $1.65 billion dollars in tax credits. So it seems that because we don't have an energy policy in our country—or at least a national energy policy—that the States and the Federal Government seem to every Congress or every State Legislature will pick which

industries will support their regional economies or national agenda at the time. But there is nothing that seems to be uniform.

And also to say that the President is not pro-science because he supported subsidies, also, I think, doesn't help the debate. It just divides us further.

And, you know, I think, Mr. Woolf, I want you to expand on talking about all of the above, because it sounds like we can find as many winners as possible when we have an all-of-the-above approach. And we can also root out the industries that aren't going to work, and doesn't that seem like a better way to allow us to explore what is going to drive and power our energy economy?

Mr. WOOLF. I think that is exactly right. The Nation has a tremendous amount of strengths in all our different regions, in all our different States. They can all contribute something different to our overall energy mix. And that is part of what the Advanced Energy Economy brings to the table is we have got in our group all different technologies. And what binds them together is they all recognize that the energy system of the last 100 years is fading away. The model of centralized generation distributed on a one-way wire is pre-Internet. You know, in this connected world, we have got smart grids, distributed generation, demand-side technologies. We no longer have the old energy grid. And in order to be competitive in the 21st century, we need a 21st-century energy system. That is going to be driven by innovation and that is what we are suggesting that Congress consider with our principles today.

Mr. SWALWELL. And do you see a role for tax credits not just for renewables but also for other sources of energy?

Mr. WOOLF. Absolutely. I think we should be applying the same standard to all technology where every innovation is needed, and then it should sunset and expire once that technology is mature and it is no longer needed.

Ms. HUTZLER. I would like to address some of the things that you mentioned that I said. First of all, in the terms of political cronyism, I didn't come up with the number, but a study came up with the number that it was 60 percent. Now, I didn't mean that it is 100 percent and my written testimony indicates that.

Furthermore, I wanted to mention about the States. There is an example that I have my testimony about a wind farm, Shepherds Flat, in Oregon. That wind farm was a $1.9 billion project. The amount of subsidies that are allocated to it are $1.2 billion. That is 65 percent. The sponsors only put 11 percent of equity in and their return is 30 percent. Pretty amazing. But a good portion of those subsidies are state-related. And in fact, the authors of the memo, which include Summers, Kaine, and Browner, all members of the Administration at that time in 2010, indicated that this project would have gone on anyway just because of the state subsidies and that the federal subsidies weren't needed, that private funding would have been provided for the project.

Mr. SWALWELL. But Ms. Hutzler, wouldn't you agree that subsidies are being provided industrywide? It is not only limited to renewables, that oil and gas also receive subsidies and tax credits, and oftentimes, those subsidies and tax credits don't have a great return on investment either?

Ms. HUTZLER. As I mentioned before, most of the—what oil and gas are getting are tax deductions that are going mainly to the independent producers. Other than that, they are also manufacturing credits that are got. And the oil and gas industry pays less than other manufacturers do in terms of—I mean there—the deductions they get is less than what other manufacturing companies get. So these aren't apples—these are apples and oranges, essentially. We are not comparing the same types of subsidies.

Mr. SWALWELL. If it was up to you, would the government have any role in subsidies, tax credits, or incentives to solve our energy solutions?

Ms. HUTZLER. Well, certainly, right now, we—I think we have a bigger problems than trying to figure out how to subsidize things that just aren't competitive in the marketplace.

Mr. SWALWELL. All right, thank you.

Thank you, Madam Chair.

Chairwoman LUMMIS. I thank the gentleman and now recognize for five minutes the Committee Chairman, the gentleman from Texas, Mr. Smith.

Chairman SMITH. Thank you, Madam Chair.

Dr. Dinan, let me ask you a question, and it goes beyond your testimony, so if you could just give us an estimate. And my question is this: on the Production Tax Credit for wind energy that began 21 years ago, 1992, what is the total cost to the taxpayer so far of all that Production Tax Credit in those 21 years, if you know it? If you can only go back five years, that would be helpful, too, but I just want to get an estimate as to how much it has cost.

Dr. DINAN. I am sorry, but I only have the estimate for the Production Tax Credit for 2013 so——

Chairman SMITH. Okay. As I understand it, just looking at it, and what was the estimate for 2013?

Dr. DINAN. That was $1.7 billion.

Chairman SMITH. Okay. It looks like it has probably been more in the last four years. And I wouldn't want to give too much of an estimate, but it might well be $10 billion in the last several years. Is that possible?

Dr. DINAN. I just don't have those numbers available.

Chairman SMITH. We will get them, or if you can help us get them, that would be great.

Ms. Hutzler, let me ask a question to you. And this is in reference to a chart you mentioned a few minutes ago that I just saw about the time you mentioned. The chart is estimated leveled cost of new electric-generating technologies in 2017. And we put it up on the screen there.

[Chart]

Chairman SMITH. Looking at this chart, if you look at the column four from the right, we see that the cost of—and by the way, there are 16 different sources of electricity, 16 different bars there. Wind offshore is by far the most expensive, and in fact, it looks to me like it is three times as expensive as wind onshore, which is right to the left of that longest bar. That is amazing to me. That is the first time I have seen a cost comparison where it is three times as expensive offshore as onshore. For the sake of the consumers, it seems to me that if we are going to advocate for wind turbines, we

ought to put them on land onshore rather than offshore. Is there something I am missing there, or would you agree?

Ms. HUTZLER. I definitely agree with you, but I just also want to mention that these numbers are out of date. EIA came up with a new set of numbers and solar thermal is actually the most expensive now than offshore wind, and it is not a factor of three anymore. It is 2.6 times.

Chairman SMITH. Oh, well, I was about to ask you if it was in the same order of magnitude, and it sounds like it is. So it is 2.6——

Ms. HUTZLER. Yes.

Chairman SMITH [continuing]. Times more expensive offshore than onshore?

Ms. HUTZLER. Correct.

Chairman SMITH. Okay. So it makes the same point. I thank you for that.

Mr. WOOLF. Mr. Chairman, could I offer a slightly different perspective on this chart?

Chairman SMITH. Because of my limited time, if you want to be very brief, you can, but I have a question for you and—up next as well.

Mr. WOOLF. My only comment is that I would urge the Congress to be investigating innovation in the technologies where they need it.

Chairman SMITH. That is my next question. Wait a minute. Stop right there.

Mr. WOOLF. Beautiful.

Chairman SMITH. Let me address the next question to Ms. Hutzler and to you, and it is this: if we want to help these two technologies become more competitive, shouldn't we be, in fact, I will use the word diverting, perhaps, the money from the subsidies into technology into coming up with these innovations that will, in fact, make these new technologies more cost effective?

Mr. WOOLF. Thank you, Chairman. That is—I think that is the right—I think Congress should be looking at a principled approach to be looking for all of this. What is our goal? What do we want to achieve? And how do we get there?

Chairman SMITH. Right.

Mr. WOOLF. And we should be looking at all the technologies, using the same standard. So I think it is perfectly appropriate to be looking at the mature technologies, getting rid of their subsidies, and therefore, spending scarce dollars on the technologies that could really benefit from innovation.

Chairman SMITH. That is where we invest not only in the future but sometimes in the distant future, but it pays off both for the consumer and for the advancement of——

Mr. WOOLF. And that is what fracking has showed us.

Chairman SMITH. Right. Ms. Hutzler.

Ms. HUTZLER. Personally, I don't think we can afford the money to do that either. And if you take a look at natural gas prices, as I said, EIA only expects them to go up four percent in real terms in like the next six years, by 2020.

Chairman SMITH. Okay.

Ms. HUTZLER. These technologies still aren't going to be competitive.

Chairman SMITH. By the way, I don't disagree with that either. Natural gas is abundant, relatively inexpensive, and pretty clean, so we ought to be using more natural gas than we are right now as well.

Thank you all for your testimonies. Thank you, Madam Chair.

Chairwoman LUMMIS. I thank the gentleman and now recognize the Chairman Emeritus of this Committee, the gentleman from Texas, Mr. Hall.

Mr. HALL. I might yield Mr. Woolf a little more time to answer the Chairman here if you need it.

Mr. WOOLF. Thank you. I got a chance to make my comment.

Mr. HALL. I probably ought to ask Dr. Dinan, but the hearing seemed like it is focused primarily on financial support for various sources of energy and a lot of other types of support that exist. Let me go to Ms. Hutzler. Biofuels, I am reading here that biofuels enjoyed various tax credits and financial support in 2011. Tax incentives for biofuels cost $7.6 billion. Now, how has this support impacted the competitiveness and the viability of the biofuels industry if it has?

Ms. HUTZLER. Well, it certainly has influenced it, but the major subsidy or financial intervention is the renewable fuels standard that is mandating a certain amount of production. So, for instance, that biofuel subsidy expired at the end of 2011, but these mandates are still increasing the amount of biofuels that are being produced. And now, we actually even have a problem because the amount of gasoline consumption isn't in concert with these increases. So in fact, rather than having 10 percent ethanol added to gasoline, we are actually talking about 15 percent now. Of course, ethanol has a lower efficiency, and so you get less mileages—mileage in your vehicle than you used to.

Another big issue in terms of the renewable fuel standard deal is with the fact that we are making most of it from corn—actually, all of it right now from corn. That has increased our fuel prices. Corn used to sell for $2.50 a bushel. Now, it is selling for over $7 a bushel. So all of these mandates, subsidies, are causing the American consumer to have higher fuel costs.

Mr. HALL. Well, I would go further, Mrs. Hutzler. You are on the role of Renewable Portfolio Standards. I think it was announced that wind was the largest source of newly installed electricity capacity during 2012, and the wind industry regularly touts this growth is a sign of technology's growing competitiveness. I don't know about that, but in the recent fiscal cliff deal, the Production Tax Credit was extended for another year at the cost of $12 billion. Now, my question is, is wind cost competitive with the PTC? If not, when if ever is it expected to be?

Ms. HUTZLER. I am sorry. I have a hard time seeing it being cost competitive in the near future, as I have mentioned before in my remarks. The Renewable Portfolio Standard is really driving most of the renewables that we are seeing today, particularly wind. If you take a look at a graph that I had in my written testimony from the Energy Information Administration, you will see that the Production Tax Credit started in 1992, but we didn't see a lot of wind

additions until 1999, when taxes put forth their Renewable Portfolio Standard. And then, as the other States that have Renewable Portfolio Standards added theirs in 2004 to 2007, you start seeing the increase in wind.

Mr. HALL. As you talk about, if individual States are mandating the purchase of renewable-generated electricity, then I guess my question is, why does the Federal Government still have to subsidize it?

Ms. HUTZLER. Frankly, I don't think it does. I think that is where we get into these duplicative subsidies that I mentioned before with the Shepherds Flat example, where we are seeing 65 percent of the project being subsidized.

Mr. HALL. I may have further questions. If I do and the Chair allows them to answer them later, we will send them to you. I think we have a vote or something. I yield back my time if I have any time left.

Chairwoman LUMMIS. Well, I thank the gentleman.

And I want to compliment the witness for keeping her concentration during that series of bells and whistles. That can be tremendously distracting.

Because we have votes that have just been called and we have about 12 minutes left to go vote, I do want to wrap up the hearing and have just a couple bits of housekeeping to do prior to doing so. First of all, I ask unanimous consent to enter into the record the following three items: an op-ed that appeared in the *Wall Street Journal* earlier this week written by Bjorn Lomborg and entitled "Green Cars Have a Dirty Little Secret," an article that appeared in the *Wall Street Journal* last week entitled "Chinese Solar Approach Faces Test," and a report by the American Energy Alliance and the National Center for Public Policy Research entitled "Erroneous Numbers, Erroneous Conclusions: The Navigant Wind Jobs Report."

Without objection, so ordered.

[The information may be found in Appendix 2.]

Chairwoman LUMMIS. I am glad that that was called "Erroneous Numbers, Erroneous Conclusions: The Navigant Wind Jobs Report." I was afraid it was going to say "Erroneous Numbers, Erroneous Conclusions: Republican Pollsters Blow November Election."

Well, I would like to thank the witnesses for their valuable testimony and the Members for their questions. The Members of the Committee may have additional questions for you, and we will ask you to respond to those in writing. The record will remain open for two weeks for additional comments and written questions from Members.

Again, thank you, witnesses for your patience, and Members of the Committee. The witnesses are excused, and this hearing is adjourned.

[Whereupon, at 4:57 p.m., the Subcommittee was adjourned.]

Appendix 1

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
Subcommittee on Energy

Hearing Questions for the Record
The Honorable Cynthia Lummis

Federal Financial Support for Energy Technologies: Assessing Costs and Benefits
Dr. Terry Dinan

1. Your testimony states "The production and consumption of energy causes environmental damage that is not borne directly by households and firms in proportion to their production or use of energy. For example, coal combustion emits carbon dioxide as well as sulfur dioxide, which causes damage to downwind lakes and contains particulates that increase the incidence of asthma. Similarly, gasoline combustion releases CO_2 and smog-causing emissions that increase the incidence of respiratory-related illnesses and death."

   Both of these statements directly suggest—and are at best ambiguous—that carbon dioxide emissions cause asthma and respiratory-related illnesses and death. What scientific evidence supports this assertion? If your intent was not to link CO2 with health and environmental problems, will you remove this ambiguity through a revision to this section of the report?

Response: Emissions of CO_2 have not been linked to asthma or other respiratory-related illnesses. However, combustion of coal and gasoline results in emissions of other pollutants that are linked to such illnesses. For example, coal combustion results in emissions of sulfur dioxide that cause damage to downwind lakes and increase the incidence of asthma. Similarly, gasoline combustion releases smog-causing emissions that increase the incidence of respiratory-related illnesses and death. Those are the effects that are identified in our testimony, and we are sorry if some people have misread those statements.

2. A recent CBO report concluded that the lifetime costs of an electric vehicle are generally higher than those of a conventional vehicle or traditional hybrid vehicle, even with the tax credits. Will you please you explain how CBO arrived at these conclusions, and the degree of difference in lifetime costs between alternative vehicles and those with traditional combustion engines?

Response: CBO evaluated the difference between the costs to purchase and operate an electric vehicle and those of a conventional or hybrid electric vehicle of comparable size and performance over the life of the vehicle. Electric vehicles cost more to purchase but less to operate than the other types of vehicles. Estimates of the cost of purchasing electric vehicles were derived from a number of recent studies of current and projected prices for such vehicles. Projections of the cost of driving those vehicles

over their operating life were based on estimates about how extensively electric vehicles will be driven on electric or gasoline power, prices for those fuels, and how much of those fuels are required for a mile of travel. Like the additional cost necessary to buy electric vehicles, CBO based estimates of driving behaviors, fuel prices, and fuel economies on a number of recent studies and publicly available data.

Because the cost of purchasing and operating an electric vehicle depends on the size of the battery in those vehicles (measured in kilowatt-hours of capacity), CBO calculated a range of relative costs. For example, CBO's analysis concluded that a plug-in hybrid vehicle with a 4 kilowatt-hour battery (the smallest size battery eligible for a federal tax credit) costs—in the absence of the electric vehicle tax credits—about $2,400 more in present-value terms than does a conventional vehicle of similar size and performance, whereas a 16 kilowatt-hour plug-in hybrid (which receives the largest federal tax credit) costs about $12,000 more. Thus, the $2,500 tax credit available on 4 kilowatt-hour vehicles is sufficient to offset their higher cost, but the $7,500 tax credit for 16 kilowatt-hour vehicles is not. For more information, see Congressional Budget Office, *Effects of Federal Tax Credits for the Purchase of Electric Vehicles* (Sept. 2012), http://www.cbo.gov/publication/43576. Details about the technical assumptions underlying CBO's analysis are discussed in the Appendix to that report, which is found on pages 29 through 33.

a. Given the size of the tax break and the fact that these vehicles still do not achieve cost parity, do you consider the tax break to be cost-effective?

Response: One measure of the cost-effectiveness of the tax credits is the average amount paid by the government to increase by one the number of electric vehicles sold. That average cost per additional vehicle is higher than the credit received by each individual buyer because some of the credits are provided on sales that would have taken place even without the credits. CBO estimates that the tax credits are currently responsible for about one-third of the vehicles sold, so the cost to the government of increasing the number of electric vehicles sold is about triple the cost of the credit. The credit ranges from $2,500 to $7,500, depending on the size of the vehicle's battery. Because not all buyers of electric vehicles receive the same size credits, the average cost to the government is likely to be between about $10,000 and $20,000 per additional electric vehicle sold. CBO expects that the average cost will decline in coming years: As electric vehicle prices decline and the tax credits come closer to achieving cost parity between electric and non-electric vehicles, the credits are likely to be responsible for an increasing fraction of electric vehicle sales.

Another gauge of cost-effectiveness is the cost the government incurs from the tax credits for each unit of reductions in gasoline use or in greenhouse gas emissions that results from driving electric vehicles in place of other similar vehicles. That assessment can be limited to the direct effect of the credits on the purchases and use of electric vehicles, or can encompass other, broader factors that offset some or all of that direct effect. In itself, the direct effect leads to lower gasoline consumption and fewer emissions than would otherwise be the case. The cost to the government of those reductions in gasoline consumption and emissions stemming from the electric vehicle tax credits can vary widely. For example, by CBO's estimates, the cost of reducing gasoline consumption ranges from about $3 to $7 per gallon

saved when, because of the tax credit, people buy an electric vehicle that is similar in size and performance to a conventional vehicle with average fuel economy, depending on the electric vehicle's type and battery size. The cost per metric ton of carbon dioxide equivalent (CO_2e) emissions reduced can vary even more widely—from $230 to $4,400 in CBO's estimates for electric vehicles that are comparable to average-fuel economy conventional vehicles.

However, because of their other, indirect effects, the tax credits will have little or no impact on the total gasoline use and greenhouse gas emissions of the nation's vehicle fleet over the next several years. In particular, increased sales of electric vehicles allow automakers to sell more low-fuel-economy vehicles and still comply with the federal standards that govern the average fuel economy of the vehicles they sell (known as CAFE standards), leaving overall fuel consumption and greenhouse gas emissions largely unaffected by the added sales of electric vehicles. As a result, the cost per gallon or per metric ton of any such reductions will be much greater during the time the CAFE standards are in effect than is implied by estimates of the direct effects alone.

b. Does this tax break present any indirect costs to the federal government, such as loss of revenue from gasoline taxes?

Response: The tax preferences for electric vehicles probably result in indirect effects—potentially both benefits and costs—that CBO did not estimate. For instance, to the extent that the tax credit results in reduced gasoline consumption, it reduces revenue from the federal tax on gasoline. The electric vehicle tax credits will probably not reduce those receipts during the period over which CAFE standards are currently established. Consequently, increased sales of electric vehicles will have little impact on overall gasoline use, and, therefore, on federal gasoline tax revenues. Electric vehicle tax credits could have a longer-term impact on gasoline tax receipts if increased sales of electric vehicles led policymakers to set future CAFE standards at higher levels than they would otherwise. For more information, see Congressional Budget Office, *Effects of Federal Tax Credits for the Purchase of Electric Vehicles* (Sept. 2012), http://www.cbo.gov/publication/43576 and Congressional Budget Office, *How Would Proposed Fuel Economy Standards Affect the Highway Trust Fund?* (May 2012), http://www.cbo.gov/publication/43198.

Another factor that could affect the government's costs is the possibility that owning an electric vehicle might cause people to change how they drive, possibly driving more (because the cost per mile would be lower) or driving less (out of concern about exhausting the charge in the battery). Such changes could affect the need for roads and the costs for road repairs.

c. In addition to the tax credit for the purchase of these vehicles, what forms of financial support are available for the development and manufacturing of these vehicles? Is there financial support for infrastructure that supports these vehicles, such as charging stations?

Response: In addition to the tax credit for purchasing electric vehicles, the federal government has provided roughly $2 billion in grants to battery manufacturers and suppliers of intermediate and component parts for electric vehicles under the Electric Drive Vehicle Battery and Component

Manufacturing Initiative. The Department of Energy's Transportation Electrification Initiative has also made about $400 million in commitments for grants for demonstration, deployment, and education projects involving electric vehicles. That initiative is intended to enhance the appeal of electric vehicles to consumers by promoting vehicle awareness and expanding the infrastructure for charging them. Finally, the Advanced Technology Vehicles Manufacturing program provides loans to U.S. automakers and parts manufacturers to help offset the cost of reequipping, expanding, or establishing plants to produce high-fuel-economy vehicles and their component parts. Some of the loans thus far provided have supported the production of electric vehicles as opposed to other vehicle technologies. In addition to those federal policies, many states offer incentives for electric vehicles, such as tax credits, exemptions from state and local taxes, and preferential access to high occupancy-vehicle lanes.

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
Subcommittee on Energy

Hearing Questions for the Record
The Honorable Randy Neugebauer

Federal Financial Support for Energy Technologies: Assessing Costs and Benefits
Dr. Terry Dinan

1. Please discuss some of the costs associated with integrating renewable energy into the electric grid, associated reliability issues and resulting transmission costs. What steps must baseload providers (coal, gas, and nuclear) take to ensure continued reliability when newly installed wind or solar is added to the grid? Are increased costs incurred by base-load providers offset through subsidies or other support? Are such costs passed along to consumers?

Response: Policies that require additional use of renewable electricity (beyond the amount that generators would have used in the absence of the policy) generally increase generation costs and lead to higher electricity prices. Those higher costs stem, in part, from the need to overcome challenges posed by two unique characteristics of renewable energy sources: They are typically available only in specific locations, and some forms of renewable energy are only available on an intermittent basis.

Most forms of renewable generation are better suited to some locations than others, and many of those places are far from large population centers that have high demand for electricity. Modest increases in the use of renewable sources could be made without significantly changing the infrastructure for distributing electricity: Those increases could take place in windy or sunny areas and be used to meet local demand for electricity. However, substantially boosting reliance on renewable generation would require transporting the power to areas that consume large amounts of electricity—a process that would entail costly and time-consuming expansions of transmission capacity.

Finding sites for new transmission lines can require obtaining permission from numerous government entities, because many lines cross multiple counties and states. On average, siting a new transmission line takes 14 years. In addition, building transmission lines entails resolving difficult questions about how the cost of that capacity should be allocated among ratepayers in various states. Once constructed, transmission lines could be used by generators or customers who were not envisioned in the initial plan; thus, the initial allocation of cost might need to be renegotiated.

In addition to the location constraints associated with renewable sources of power, some renewable sources, such as wind and solar, can generate power only part of the time because the wind does not always blow and the sun is not always visible. On average, wind plants produce just 34 percent of the

electricity that they could if they operated continuously; solar plants produce 22 percent to 31 percent of their theoretical full capacity, depending on the type of plant. As a result of those low "capacity factors," the capital costs of building wind and solar plants are spread over a fairly small amount of generation, and hence the plants tend to have relatively high average costs. That intermittency, together with a lack of a low-cost way to store electricity, also means that wind and solar power cannot serve as a source of continuous electric power, as base-load generation through coal combustion does. Finally, periods of high wind or bright sunshine may not correspond with the periods when the value of electricity, and thus the price that generators could charge for it, is highest. That fact tends to limit the potential for renewable generation to be dispatched (or increased quickly) when the demand for electricity is greatest.

An additional megawatt of solar or wind capacity cannot substitute for an additional megawatt of nonrenewable capacity because those renewable sources are available only intermittently. For example, given the current generation mix in the United States, the Energy Information Administration estimates that 50 megawatts of wind capacity would be required to replace 20 megawatts of natural-gas-fired capacity. In the absence of a low-cost means of storing electricity, the intermittent nature of wind and solar energy would significantly limit their ability to provide the majority of the nation's electricity, even if all regions were equally well suited for such generation.

The additional costs associated with the location constraints and intermittency generally lead to higher electricity prices. For example, CBO found that either a renewable or clean electricity standard, either of which would require a greater share of electricity generation in the United States to come from renewable sources, would raise the average cost of generating electricity. For more information, see Congressional Budget Office, *The Effects of Renewable and Clean Electricity Standards* (July 2011), www.cbo.gov/publication/41451.

Hearing Questions for the Record
The Honorable Cynthia Lummis

Federal Financial Support for Energy Technologies: Assessing Costs and Benefits
Ms. Mary Hutzler

1. Please provide any additional comments on the Congressional Budget Office testimony on energy subsidies.

The following are comments regarding the testimony prepared by the Congressional Budget Office (CBO).[i] The statements and page numbers refer to the CBO testimony.

Statement on page 1: Tax preferences for fuels and energy technologies were first established in 1916. For most years until 2005, the largest share of the support they provided went to domestic producers of oil and natural gas.

Comment: According to the Energy Information Administration (EIA), in fiscal year 1999, 58 percent of tax expenditures went to oil and natural gas and 31 percent went to renewable energy. However, if you consider all subsidies directed to these industries, including federal government direct expenditures, tax expenditures, and research and development funds, 28 percent were directed to oil and gas while 22 percent were directed to renewable energy and conservation.[ii] Further, in 1999, oil and gas produced 49 percent of our domestic energy, while renewables produced only 9 percent, with hydroelectric power producing half of the renewable amount, but getting a very small share of the renewable subsidy. (1999 was the only year that the EIA website had subsidy information prior to 2005.)

Statement on page 1: Most of the support for energy efficiency and renewable energy comes from provisions that have already expired or are scheduled to expire at the end of 2013. In contrast, most of the support for fossil fuels and nuclear power comes from provisions that are permanent.

Comment: The Production Tax Credit for wind was first instituted in 1992 by the Energy Policy Act of that year and has been extended 8 times. Its current extension is through the end of this year and was legislated by the American Taxpayer Relief Act of 2012. However, while expiring at the end of 2013, any wind farm that begins construction in 2013 will have 10 years of tax credits coming once it begins operation. The original law and the previous extensions mandated that the wind farm begin operation before the tax credit was to sunset. The Investment Tax Credit for solar energy originated with the Energy Tax Act of 1978 and was made permanent by the Energy Policy Act of 1992.

The major tax deductions provided to the oil industry primarily affect small independent producers, to encourage them to produce oil in the United States. These tax deductions are the percentage depletion allowance and expensing of intangible drilling costs. As the oil and gas in a well is depleted, independent

producers are allowed a percentage depletion allowance to be deducted from their taxes. While the percentage depletion allowance sounds complicated, it is similar to the treatment given businesses for depreciation of an asset. The tax code essentially treats the value of a well as it does the value of a newly constructed factory, allowing a percentage of the value to be depreciated each year. This allowance was first instituted in 1926 to compensate for the decreasing value of the resource, and was eliminated for the major oil companies ("Big Oil") in 1975. It saves the independent oil and gas producers about $1 billion in taxes per year.

Oil and gas producers are also allowed to count certain costs associated with the drilling and development of wells as business expenses. The law allows the small producers to expense the full value of these costs, known as intangible drilling costs, every year to encourage them to explore for new oil. The major companies get a portion of this deduction—they can expense a third of intangible drilling costs, but they must spread the deductions across a five-year period. This tax treatment is also similar to that of other businesses for such investments as research and development (e.g. Apple or the pharmaceutical companies). If the products developed from research and development are successful, people benefit and profits are generated which are then taxable.

Oil companies, like other manufacturing businesses, receive the Domestic Manufacturing tax deduction, the purpose of which is to encourage companies to continue to produce products in America. The United States now has the highest effective corporate tax rate in the world among developed countries, and due to those high tax rates, companies have been making investments overseas. The Domestic Manufacturing tax deduction allows all industries and businesses (not just oil companies) to deduct a certain percentage of their profits—for the oil and gas industry, it is 6 percent, for *all* other industries (software developers, video game developers, the motion picture industry, among others), it is a 9 percent deduction. It saves the oil and gas industry (mostly independent producers) about $1.7 billion in taxes per year.

Oil and gas companies pay, on average, a tax rate greater than 41 percent. In comparison, other S&P companies pay an average of 26.5 percent.[iii] ExxonMobil, for example, paid $3 in taxes for every $1 in profit. USA Today recently reported on the top 10 companies paying the most in taxes in fiscal year 2012. Of those 10 companies, 3 were the large, major oil companies (ExxonMobil, Chevron, and ConocoPhillips). ExxonMobil paid the most taxes: $31 billion in fiscal year 2012, followed by Chevron with $20 billion. These 3 oil companies paid over 50 percent of the taxes that the top 10 highest tax paying companies paid, and the taxes that Exxon Mobil and Chevron paid on earnings were substantially higher than all of the other businesses.[iv]

Statement on page 1: Without government intervention, households and businesses do not have a financial incentive to take into account the environmental damage or their costs to the nation associated with their choices about energy production and consumption. The most direct and cost-effective method for addressing that problem would be to levy a tax on energy sources that reflects the environmental costs associated with their production and use.

Comment: European countries signed the Kyoto treaty and instituted a cap and trade program that has not measurably altered their greenhouse gas emissions compared to non-signatories such as the United States. In fact, Europe countries (e.g. Germany) are building coal fired power plants in lieu of natural gas-fired plants and to back-up their intermittent renewable technologies, wind and solar power, because natural gas is more expensive than coal in many European countries, and solar and wind power cannot be relied upon to generate electricity when needed since they only produce power when the sun shines and the wind blows. So, even with a cap and trade program, Europe burned more coal in 2011 (the most recent year of data available from EIA) than it did in 2009 and 2010.

China, India, Russia, and Germany, to name a few, are building coal-fired power plants. Worldwide coal plant construction grew 5.4 percent over the past year and now represents about 30 percent of installed capacity. According to the World Resources Institute, almost 1,200 coal-fired power plants are in the planning stages (a capacity of 1.4 million megawatts) and over three-quarters of them are to be built in China and India, where over 500,000 megawatts each are currently planned for construction.

Since greenhouse gas emissions are a global issue, the United States acting unilaterally would do little to reduce global greenhouse emissions and only make U.S. residents fuel poor by driving up energy prices. China, for example, consumes almost 4 times the amount of coal that we consume and emits the largest amount of greenhouse gases in the world. The climate change literature refers to the problem of "leakage" whereby attempts to penalize carbon emissions in one jurisdiction are partially offset when the emitters simply change jurisdictions.

Further, if we take into account the "tax interaction effect"—where a new carbon tax, though justified in a vacuum, actually exacerbates the pre-existing inefficiencies of other taxes—the empirical case for a carbon tax becomes weaker. The federal government already has numerous policies in place that discourage carbon emissions and encourage substitutes. Even if one endorses the idea that government action needs to correct for an underlying "market failure," it may be the case that this is already being accomplished with existing policies and regulations.

Statement on page 1: Also, unless the government intervenes, the amount of research and development that the private sector undertakes is likely to be inefficiently low from society's perspective because firms cannot easily capture the "spill-over benefits" that result from it, particularly in the early stages of developing a technology.

Comment: It is the private sector and the market that has determined and built most of the technologies that have been successful in the United States. For example, the most important technological advancements and biggest change in energy production in the last couple decades -- hydraulic fracturing coupled with directional drilling-- was initiated by the private sector. Hydraulic fracturing was first used in the mid-to-late 1940s by the private sector. It was not until the 1970s that the Department of Energy spent a small amount of R&D funds on the technology. The hydraulic fracturing revolution shows why the market is superior to government subsidies in selecting winning technologies. It has dramatically lowered natural gas prices, increased oil production on non-federal lands at the fastest rate since 1859, created jobs, and led to real benefits for Americans. According to

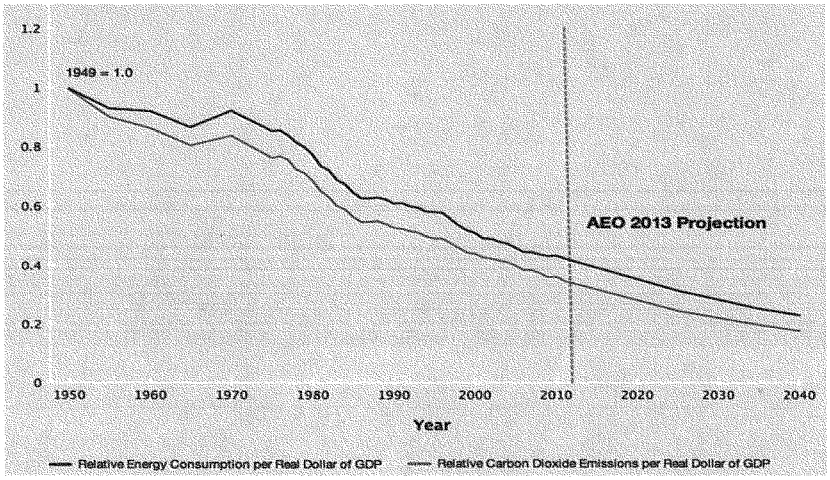
Daniel Yergin, production of unconventional oil and gas has generated 1.7 million jobs and could generate 3 million jobs by 2020. In 2012, this revolution added $62 billion to federal and state government revenues that could rise to about $113 billion by 2020, according to Yergin.[v]

Although it is theoretically possible to identify reasons that the market would provide an inefficiently low amount of investment in certain areas of research and development, at the same time there are reasons to be wary of "government failure." It is naïve to think that policymakers have the requisite knowledge and incentive structure to identify areas of "market failure" and to offset them, without falling into the trap of spending too much taxpayer money or spending it on the wrong outlets.

Statement on page 2: From 1916 to the 1970s, federal energy-related tax policy focused almost exclusively on increasing the production of domestic oil and natural gas; there were no tax incentives for promoting renewable energy or increasing energy efficiency. In the 1970s, lawmakers began adding tax preferences for new sources of fossil fuel, alternatives to fossil fuel, and energy efficiency.

Comment: As explained above, in 1978, lawmakers provided a 10 percent investment tax credit to solar energy through the Energy Tax Act of that year. Moreover, energy efficiency did not begin with tax policies in the 1970's, but rather, as a normal human goal. Back in 1741, for example, Ben Franklin invented the Franklin Stove as a more efficient means of heating homes. As the chart below demonstrates, energy use per dollar of GDP was already well established on a downward trend well before the tax policies mentioned by CBO.

Energy Consumption and Carbon Dioxide Emissions per Dollar of GDP



Source: http://blogs.the-american-interest.com/wrm/2013/03/01/us-getting-more-economic-bang-for-its-energy-buck/

Statement on page 6: Most of the support for energy efficiency and renewable energy in 2013 comes from provisions that are temporary. In contrast most of the support for fossil fuels and nuclear energy comes from provisions that are permanent.

Comment: As explained above, there is a permanent 10 percent investment tax credit for solar energy, made permanent by the Energy Policy Act of 1992. Also, the entire panoply of tax deductions and treatments that exist for other businesses akin to those for the oil and gas industry, including business deductions, research and development, amortization of investment properties and the like, also apply permanently for all renewable energy sources. While they may be called something different in the tax code, they serve the same purpose. The renewable energy industries, like other industries, use whatever tax treatments are available to minimize taxes and reinvest in their technologies.

Statement on page 7: In 2009, DOE received $39 billion (in current dollars) for support of energy technologies (after accounting for rescissions and transfers)—roughly 17 times the average annual appropriation for the preceding decade. .... Although ARRA funds have generally been spent more rapidly than funds that DOE has received through the normal appropriation process, roughly $5 billion of ARRA funding for the fuels and energy technology programs remain unspent.

Comment: The stimulus funding in 2009 from the American Recovery and Reinvestment Act (ARRA) totaled $787 billion[vi], and most of those funds have been paid out according to the government's website[vii]. Over $90 billion was earmarked for 'green programs.' However, the total that went to green energy projects is not clear. Brookings estimated it at $51 billion, with a total government spending (both stimulus and non-stimulus) on green initiatives at $150 billion through 2014.[viii]

Unfortunately, about 50 firms receiving government funds are either bankrupt (23) or are having difficulties (27), and many of the latter are in financial trouble.[ix] Over $15 billion of taxpayer money is either gone or at risk. Further, 29 of the 50 companies had or have political connections, putting the percentage of political cronyism at almost 60 percent.

Many of the loans/loan guarantees were pushed quickly through the system by DOE because of political pressure to the detriment of the American taxpayers, the most famous of which is Solyndra, a solar manufacturer that received almost all of the $535 million loan awarded it before filing for bankruptcy in 2011. The cause of Solyndra's demise was its complicated technology that required a custom manufacturing facility and an expensive price tag.

Abound Solar, another solar manufacturer that received a DOE loan guarantee for $400 million, filed for bankruptcy in June 2011 after it had laid off 70 percent of its workforce that February.[x] According to the Daily Caller, Abound Solar sold defective or underperforming products, and company personnel claimed DOE officials knew their panels were faulty before they received taxpayer dollars.[xi] Virtually all of the panels Abound manufactured underperformed, putting out between 80 and 85 percent of the promised wattage and leading to tens of thousands of panels having to be replaced, particularly towards the end of the company's life.

First Solar, one of the biggest recipients from DOE's loan guarantee program, garnered over $3 billion[xii] before the program expired at the end of September 2011.[xiii] At the time, DOE was under pressure not to repeat its prior mistakes, but again the agency provided a loan guarantee to a losing company. For example, early in 2012, First Solar laid off half of its employees at its Antelope Valley Solar Ranch One project in the Southern California desert, which was the recipient of a $646 million loan guarantee that was to create 350 construction and 20 permanent jobs. Further exploiting taxpayers dollars, in 2011, First Solar paid its top eight executives almost $16 million. Rob Gillette, who was terminated as CEO of First Solar in October 2011, received more than $32 million since his employment began in October 2009. First Solar sold much of its $3 billion in federal loan guarantees to third parties before it laid off 30 percent of its workforce. Its stock price plummeted by more than 90 percent from its high in 2011, but not before its head officer received more than$329 million in stock sales since 2009.

Solar technology firms were not the only companies that received DOE awards, but are having financial problems. Fisker Automotive, a Finnish electric car maker, originally received $529 million in DOE loan guarantees, but was cut off at $193 million because it failed to reach milestones for its luxury vehicle Karma. The company suffered recalls of its extended-range electric sedan that cost over $100,000, because of technology flaws and failed batteries, which resulted in fires. The federal subsidies attracted some of the rich and famous, as it has been a favorite status purchase for Hollywood movie stars and celebrities, rappers and Hip Hop musicians, and soap opera stars. Consumer Reports gave the Karma a terrible review, calling it the worst luxury sedan on the market. On April 5, 2013, Fisker laid off 160 of its 210 employees at its Anaheim, California office. Some believe bankruptcy filing may happen soon.

Fisker's battery supplier, A123 Systems, supplied the defective batteries. A123 Systems declared bankruptcy in October 2012, but not before receiving $132 million from its $279 million DOE loan guarantee to refurbish two Michigan plants plus other projects.[xiv] Here again the loan guarantee was moved quickly by DOE. Similar to First Solar, A123's officers and directors made more than $11 million in stock sales before the bankruptcy filing.

The Heritage Foundation put together a list of 34 companies that received federal support from taxpayers that have faltered or are now faltering.[xv] These companies have either gone bankrupt, laid off workers, or are heading for bankruptcy. The list below provides the 34 companies along with the amount of money they were offered by the U.S. Department of Energy and other federal government agencies. The amount of money listed does not include other state, local, and federal tax credits and subsidies. The at-risk total is approximately $7.5 billion, of which $1.6 billion is in receivership. And the total will likely get larger as more is known about each company.

1. Evergreen Solar ($25 million)*
2. SpectraWatt ($500,000)*
3. Solyndra ($535 million)*
4. Beacon Power ($43 million)*
5. Nevada Geothermal ($98.5 million)
6. SunPower ($1.2 billion)

7. First Solar ($1.46 billion)
8. Babcock and Brown ($178 million)
9. EnerDel's subsidiary Ener1 ($118.5 million)*
10. Amonix ($5.9 million)
11. Fisker Automotive ($529 million)
12. Abound Solar ($400 million)*
13. A123 Systems ($279 million)*
14. Willard and Kelsey Solar Group ($700,981)*
15. Johnson Controls ($299 million)
16. Schneider Electric ($86 million)
17. Brightsource ($1.6 billion)
18. ECOtality ($126.2 million)
19. Raser Technologies ($33 million)*
20. Energy Conversion Devices ($13.3 million)*
21. Mountain Plaza, Inc. ($2 million)*
22. Olsen's Crop Service and Olsen's Mills Acquisition Company ($10 million)*
23. Range Fuels ($80 million)*
24. Thompson River Power ($6.5 million)*
25. Stirling Energy Systems ($7 million)*
26. Azure Dynamics ($5.4 million)*
27. GreenVolts ($500,000)
28. Vestas ($50 million)
29. LG Chem's subsidiary Compact Power ($151 million)
30. Nordic Windpower ($16 million)*
31. Navistar ($39 million)
32. Satcon ($3 million)*
33. Konarka Technologies Inc. ($20 million)*
34. Mascoma Corp. ($100 million)

*Denotes companies that have filed for bankruptcy.

Statement on page 11: Because many sectors of the U.S. economy—especially transportation—use oil, the United States is economically vulnerable to a disruption in the supply of oil. Reducing exposure to that disruption would require a large decrease in the total amount of oil consumed in the United States.

Comment: There are other ways to ensure security of supply in oil. Forecasts have shown that the United States can become independent of overseas oil by using its own vast domestic oil resources and that of its neighbors that are trusted allies. North America has 1.79 trillion barrels of technically recoverable oil, enough to last over 250 years at current usage rates in the United States.[xvi] Of that amount, over 210 billion barrels are proven reserves, equal to over 80 percent of Saudi Arabia's proven reserves.

We need to be able to move Canada's vast proven reserves to the United States by the cleanest and most economical way—one example being the Keystone pipeline that is awaiting a Presidential permit since it would cross the U.S.-Canadian border. The delay in its approval by the Obama administration has been 4 long years while Canadian oil is being transported to the United States by existing pipelines and more expensive rail that does not need a Presidential permit. Both rail and pipeline deliver more than

99 percent of products without incident. However, pipelines have a better safety record than rail. According to the American Association of Railroads, railways occur spills 2.7 times more often than pipelines; a Manhattan Institute study notes that trains spill 33 times more than pipelines.[xvii]

Further, the Obama Administration could allow oil and gas companies access to the 1.442 trillion barrels of technically recoverable oil in the United States. Production of shale oil in the United States, for example, has increased oil production on non-federal lands at the fastest rate since 1859, created jobs, and led to real benefits for Americans improving state economies where that production is taking place. The United States has almost 1 trillion barrels of technically recoverable oil shale that lie on mostly federal lands that the Obama Administration has restricted from leasing and commercial development, thereby making it harder for industry to develop the technology to drill and produce it. Areas that the federal government could open to oil gas development include:

- The 10.4 billion barrels of oil in the Arctic National Wildlife Refuge
- The 86 billion barrels of oil in the outer continental shelf of the lower 48 states
- The 896 million barrels of oil in the Naval Petroleum Reserve-Alaska
- The 25 billion barrels of oil in the outer continental shelf of Alaska
- The 90 billion barrels of oil in the geologic provinces north of the Arctic circle
- The 982 billion barrels of oil shale in the Green River Formation in Colorado, Utah, and Wyoming.

Statement on page 11: The most cost effective way to reduce the external costs associated with energy would be to enact policies, such as taxes, that would increase the prices of various types of energy to reflect the external costs that their production and use entail. That approach would provide a financial incentive for businesses and households to consider those external costs when deciding on the types and amounts of energy to use.

Comment: As mentioned above, European countries signed the Kyoto treaty and instituted a cap and trade program that has not measurably altered their greenhouse gas emissions compared to non-signatories such as the United States. In fact, European countries (such as Germany) are building coal fired power plants in lieu of natural gas-fired plants and to back-up their intermittent renewable technologies. So, even with a cap and trade program that taxes fossil fuels, primarily coal, Europe burned more coal in 2011 (the most recent year of data available from EIA) than it did in the previous 2 years.

Australia implemented a carbon tax and the country has found that businesses are going under as a result. Business insolvencies are at a record high in Australia and show that the carbon tax is doing damage since their products are having trouble competing against imports. The Australian Securities and Investments Commission recorded more than 10,500 company collapses for the first 2 months of this year. It is estimated that about 900 firms are being placed in administration every month - more than during the global financial crisis.[xviii]

Since greenhouse gas emissions are a global issue, the United States acting unilaterally would do little to reduce global greenhouse emissions and only make U.S. residents fuel poor by driving up energy prices. China, for example, consumes about 4 times the amount of coal that we consume and emits the largest

amount of greenhouse gases in the world. While they make investments in clean energy, about 30 percent of their wind units are unusable since they are not integrated with the country's electricity grid. Further, China continues to build coal-fired power plants at breakneck speeds to provide power to residents without electricity, producing more than 70 percent of its electricity from coal.

2. President Obama declared in his State of the Union speech that China has gone "all-in" on clean energy. However, a recent article in the Wall Street Journal reported China is moving to eliminate subsidies for solar manufacturers and will "allow the market to determine winners and losers."
    a. What do the apparent divergent approaches of the Obama Administration and the Chinese government tell us about the direction of energy policy in the world?
    b. I understand that China plans to add 315,000 megawatts of coal-fired electricity in the next three years. This is good news for poor Chinese seeking to rise out of poverty, but how does it square with the President's statement that China has gone "all-in" on clean energy?

According to the Organization for Energy Cooperation and Development (OECD), China will become the world's largest economy by 2016, surpassing the United States. The OECD sees China's economy growing at an average rate of 8 percent over this decade assuming its current rate of investment and reform.[xix] For economic growth, a robust energy sector is needed to provide affordable, abundant, and reliable sources of energy supplies. That is why China is investing in building clean coal generating technology and providing loans to oil rich countries in return for future supplies of oil. And while China is investing in green technology, that technology is supplying a very small percentage of its energy needs. China is already the largest consumer of energy and emitter of carbon dioxide emissions in the world.

China's Renewable Ventures

China is constructing renewable technologies, which is in line with the government's plan to have clean energy account for 11.4 percent of electricity consumption by 2015. In 2011 (the most recent year that generation data is available for China), China generated just 2.5 percent of its generation from non-hydroelectric renewables; in contrast, the United States generated 4.8 percent of its generation from non-hydroelectric renewables in that year. China is building wind and solar energy, but not all of it is operable. For example, about 30 percent of its wind energy is not connected to its electricity grid.

China first ventured into the renewable arena via the Clean Development Mechanism of the Kyoto Protocol, where developed countries that signed the Kyoto Protocol received credit for funding development of low carbon emitting projects in the developing countries. Learning quickly, the Chinese soon became major producers of renewable technologies, particularly in manufacturing solar panels -- cutting their price dramatically. Currently, there is a global oversupply of solar panels and many countries, particularly in Europe, are cutting renewable subsidies. This past December, China's State Council indicated that it would stop funding domestic solar-panel makers, instead encouraging mergers among its major companies and allowing the market to determine winners and losers.[xx]

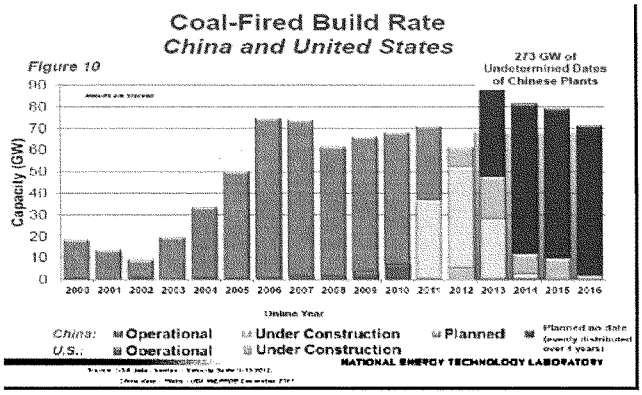
To fund a rapid expansion of manufacturing capacity, the Chinese solar industry's debt grew rapidly between 2009 and 2011. But, because solar demand has not kept up with the growth in manufacturing, solar-panel manufacturers had to cut costs and write down investments. Suntech Power Holdings

Company, one of the world's largest solar-panel suppliers, has to repay more than a half billion dollars of debt held by international investors. The company reported a net cash position of $244 million as of August 31, 2012 and debt of about $2 billion. At the end of the first quarter of last year, China's 10 largest solar companies, including Suntech, had a combined debt of $17.5 billion.[xxi] Beijing is offering indirect support to solar companies in the form of new policies and incentives for solar-power development and to help boost demand for solar panels.

China, after building scores of factories that lowered solar panel prices 20 percent in the past year, is expected to become the biggest consumer of the solar panels after doubling its 2013 target for new projects in January. As such, it is forecast to unseat Germany as the largest solar market this year. The Chinese government expects 10 gigawatts of new solar projects in 2013, more than double its previous target and three times last year's expansion. The country plans to install 35 gigawatts by 2015, compared with a previous goal of 21 gigawatts.[xxii] But, 35 gigawatts of solar capacity over several years is minor compared to the coal-fired capacity that the country is building.

China's Coal Sector and Pollution

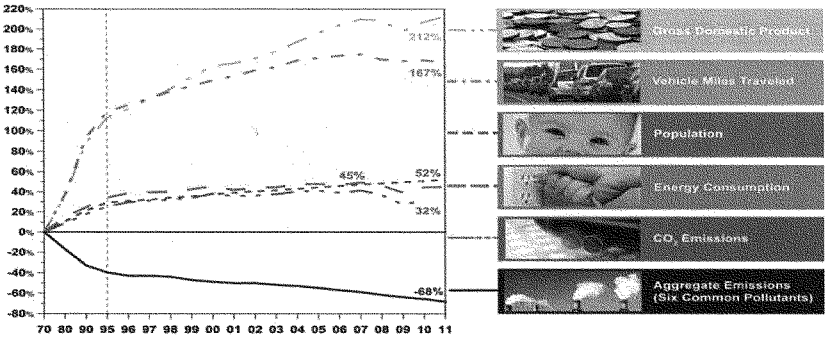
China gets over 70 percent of its electricity generation from coal. According to the National Energy Technology Laboratory, China is building at least one coal-fired unit a week. China currently produces and consumes more coal than any other country in the world. Although China's coal reserves are much smaller than ours, it consumes almost 4 times the amount of coal that the United States consumes and must import coal because its current coal production cannot satisfy its own demand.[xxiii] In 2011, China consumed more than 3.8 billion short tons of coal while the United States consumed 1 billion short tons.[xxiv] As a result, China's five north-western provinces are expected to increase coal production by 620 million metric tons by 2015, generating an additional 1.4 billion metric tons of greenhouse gases a year.[xxv]



Source: National Energy Technology Laboratory, Tracking New Coal-fired Power Plants, January 13, 2012, http://www.netl.doe.gov/coal/refshelf/ncp.pdf

China has a pollution problem and it has nothing to do with carbon dioxide. Carbon dioxide is invisible, odorless, and non-toxic. China's pollution emissions come from old coal-fired plants and its vehicles.[xxvi] Since 1970, the United States has dramatically reduced its criteria pollutants that are toxic. But, China has been unable to clean up its toxic emissions because it needs to provide energy to its population, many of whom do not have access to electricity, and because efforts to reduce these emissions have met resistance from Chinese energy companies that would need to comply with the mounting demand for more electricity. Further, penalties are low for non-compliance: fines are generally capped around $16,000, which is not much of a deterrent.

Decline in Criteria Pollutants vs. Economic Growth in the United States



According to Beijing officials, vehicle emissions account for 22 percent of the main deadly particulate matter in the air, known as PM 2.5, and another 40 percent is from coal-fired factories in Beijing and nearby provinces.[xxvii]

But, China's pollution problems are severe. More than 16,000 dead pigs have been found floating in rivers that provide drinking water to Shanghai and smog akin to volcanic fumes surround Beijing.

While China cannot afford to replace its old coal-fired technology, it is building state-of the-art coal-fired plants that have reduced criteria pollutants dramatically. In fact, as the *New York Times* has reported, China is actually constructing some coal plants that are cleaner than those allowed to be built in the United States.[xxviii] An irony of our current regulatory policy may be that China will ultimately become the world's supplier of the most advanced clean coal plants, despite the large size of the U.S. coal resource base.

China's Oil for Loans Deals

China has been making deals with oil rich countries such as Venezuela, providing loans in return for future supplies of oil. One of its newest deals may be with Russia. Russia's oil company, Rosneft, is seeking to borrow up to $30 billion from China in exchange for possibly doubling oil supplies that would make China the largest consumer of Russian oil. Rosneft wants to borrow the money in order to complete a $55 billion acquisition of TNK-BP to become the world's largest listed oil producer.[xxix] Russia has been steadily increasing its crude exports to Asia with flows expected to total around 15 percent of Russian oil exports this year via pipeline to China and to the Pacific coast. The increased shipments to Asia mean reduced shipments to Europe.

Also, China has been courting Africa for decades to satisfy its growing demand for raw materials and energy. Last year, China offered $20 billion in loans to African countries over the next three years as a no-strings-attached aid policy. However, others see China's aid and loans as a means to improve their prospects of gaining access to resources like oil, copper and timber.[xxx] Their immense foreign exchange reserves earned during the rapid growth of their economy makes the likelihood of further investments likely.

Clearly, China needs oil to fuel its growth in vehicles and transportation. The number of passenger cars in China is expected to reach 400 million by 2030, up from 90 million today. China has already surpassed the United States as the largest vehicle sales market in the world.

China's Carbon Dioxide Emissions

In spite of China's spending on renewable energy, its carbon dioxide emissions have far outpaced those of the United States. In 2012, the U.S. had decreased its carbon dioxide emissions to 5.3 billion metric tons from 6.0 billion metric tons in 2007, a 12 percent decline. Meanwhile, China emitted 8.7 billion metric tons of carbon dioxide in 2011, up from 6.3 billion metric tons in 2007, an increase of 38 percent. Forecasters have China emitting over 11 billion metric tons of carbon dioxide by 2025, over twice the amount that the United States currently emits. China is, by far, the world's largest emitter of carbon dioxide, and is rapidly increasing its lead in these emissions over the rest of the world's nations.

China knows that it needs affordable, reliable, and abundant energy to keep fueling its economy. To supply the energy, China is building coal-fired power plants, obtaining future agreements for oil supplies through aid and loans to foreign companies, importing coal and other fuels, as well as building renewable technology. But, the country is deep in haze caused by pollution from old coal-fired power plants and vehicles. Companies in China are avoiding regulations to decrease these emissions. Meanwhile, these pollution emissions are growing and so are the country's carbon dioxide emissions. Politicians who think China's energy policy is a model for the United States need to look at pictures of Beijing and statistics regarding China's emissions.

Hearing Questions for the Record
The Honorable Randy Neugebauer

Federal Financial Support for Energy Technologies: Assessing Costs and Benefits
Ms. Mary Hutzler

1. President Obama frequently urges that the U.S. should follow the "clean energy examples" set in other countries, such as Germany. However, in Germany, the cost of electricity has risen nearly 40% in the past five years and electricity prices for industry are 15% higher than the EU average. What can the United States learn from Germany's energy policy and that of others in Europe? And why would we expect the U.S. clean energy subsidy model to work better than what has been tried and failed in Europe?

For Germans, electricity prices are soaring as a result of phasing out nuclear power and mandating renewable energy. Consumers in Germany are facing the biggest electricity price increase in a decade and those price increases will continue. It is estimated that by 2030, Germany will have spent more than 300 billion Euros on green electricity. And consumer groups are complaining that about 800,000 German households can no longer pay for their energy bills.

If this rise in energy prices continues, household energy bills could exceed the rent Germans pay for housing in parts of the country. Because renewable technologies are not economic compared to traditional fossil fuel technologies, Germans have had and will continue to pay an additional increasing premium for their use. Because of this premium, electricity prices are expected to increase by over 10 percent this year—the largest increase in a decade.

The German Electricity Sector

The German government wants 80 percent of its energy to be produced by renewable sources by 2050; biomass, wind, and solar currently make up about 25 percent of the country's electricity supply.[xxxi] The country has begun to take fossil fuel power stations offline and is planning to phase out nuclear energy by 2022. However, the cost of these changes has resulted in up to 800,000 households not being able to pay their bills and placed a strain on existing capacity in the electrical grid. Although Germany has made significant investment in wind and solar power, it faces an energy shortfall, partly because it has insufficient transmission lines to bring wind power from the North Sea to the industrial centers in the south and partly because the sun doesn't always shine and the wind doesn't always blow when it is most needed.

In 2009, Germans spent about 100 billion Euros ($130.5 billion) for energy, an average of 2,500 Euros ($3,263) per household. On average 34 percent of net household income in Germany is spent on rent and energy. According to the Association of House and Apartment Owners, energy prices have increased

far more than rents in the past 15 years. And, according to the Association of Energy Consumers, heating and hot water costs comprise 41 percent of bills on average and those costs are increasing.

This year, electricity prices in Germany are expected to increase by more than 10 percent. Much of this increase is driven by a surcharge to cover the costs of using more renewable energy. The renewable surcharge is the difference between guaranteed prices mandated to be paid for renewable energy and market prices for conventional energy. The renewable surcharge will increase by *47 percent*—from 3.6 Euro cents (4.7 U.S. cents) per kilowatt hour in 2012 to 5.3 Euro cents (6.9 U.S. cents) per kilowatt hour in 2013. To put this in perspective, in the United States, the average residential retail price of electricity is 11.88 cents per kilowatt hour, so Germany's renewable surcharge in 2013 will be 58 percent of the *total* cost of residential electricity in the United States. This helps explain why residential electricity rates in Germany are almost triple those in the United States, at 34 U.S. cents per kilowatt hour.

These electricity price increases are far from over. A three-person German household paid on average 40.60 Euros ($52.98) a month for electricity in 2000; it is now 75.08 Euros ($97.98), an increase of about 85 percent. Depending on the expansion of offshore wind power and photovoltaics, electricity prices are expected to increase another 30 to 50 percent in the next ten years.

The high power costs are not only affecting households but German industry as well where its competitiveness is deteriorating. According to a recent survey by the Association of Industrial Power Industry, Germany ranks fourth in terms of having the highest industrial electricity prices in the world. Electricity is more than 30 percent cheaper for industrial companies in many Asian and European countries and it is more than 50 percent less in the United States and Russia. Businesses look for cheaper energy (i.e. electricity) when deciding where to produce products.

After Germany's four leading electrical grid operators announced that they would be increasing the charge to consumers that goes into financing subsidies for producers of renewable energy, the German government decided to extend its caps on subsidies for solar energy to more technologies including wind and biomass. The plan is designed to contain the rising costs of phasing out nuclear power. Due to the surcharge, consumers in Germany face an extra 59 Euros ($77) on their power bills this year based on an average 3-person household consuming 3,500 kilowatt hours per year. (An average U.S. home, larger and with more labor saving devices, uses about 11,500 kilowatt hours per year.)

The proposals announced to reform the clean-energy subsidy system mark the most sweeping changes to Germany's support mechanisms for renewable energy since the country adopted feed-in tariffs in 2004. Those rules granted renewable generators above-market prices for the power they produce and made Germany the world's biggest market for solar panels.

Germany spent about 16 billion Euros ($20.88 billion) on clean energy technologies in 2011; it is expected to spend 20 billion Euros ($26.1 billion) in 2013. According to a study by the Technical University of Berlin, by 2030, it is estimated that Germany will have spent more than **300 billion Euros** ($391.5 billion) on green electricity.

Germany is not the only country curbing incentives for renewable power; Spain, France, Italy and the U.K. either have or are curbing their incentives for renewable energy. For example, the U.K. cut its feed-in tariff for solar panels by almost 25 percent last year after having cut it by around 50 percent the previous year,[xxxii] and its onshore wind subsidy by 10 percent.[xxxiii] In 2009, 4 million U.K. households (18 percent of households) were in fuel poverty, having to spend more than 10 percent of their household income to keep their home in 'satisfactory' condition.

Ironically, to back-up the wind and solar energy, German utilities are using coal because it is cheaper than natural gas in Europe. For the most part, natural gas is moved through pipelines in Europe, and tends to be used close to where it originates. It is priced regionally and often linked to the price of oil. Many European gas contracts were negotiated years ago with the Russian gas company, Gazprom, and remain high. For example, in the summer of 2012, natural gas prices in Europe were more than three times the gas price in the United States and definitely more expensive than coal. According to Bloomberg New Energy Finance, at the beginning of November 2012, utilities in Germany were set, on average, to lose €11.70 when they burned gas to make a megawatt of electricity, but to earn €14.22 per megawatt when they burned coal. Analysts say a price of €20 per ton ($26 per ton) is needed for power plants in Europe to switch to low-carbon energy.

The U.K. has also seen a growth in its coal consumption. In Britain, coal consumption for electric generation increased by 31 percent between 2011 and 2012, while natural gas consumption for electric power generation dropped by the same amount, resulting in a 4.5 percent increase in carbon emissions, according to the U.K. Department of Climate and Energy.[xxxiv]

Germany's transition to intermittent green energy technologies is causing havoc with its electric grid and that of its neighbors–countries that are now building switches to turn off their connection with Germany at their borders. The intermittent power is causing destabilization of the electric grids causing potential blackouts, weakening voltage and creating damage to industrial equipment.

The Destabilization Problem

More than one third of Germany's wind turbines are located in the eastern part of the nation where this large concentration of generating capacity regularly overloads the region's electricity grid, threatening blackouts. The situation tends to be particularly critical on public holidays when residents and companies consume significantly less electricity than usual with the wind blowing regardless of the demand and supplying electricity that isn't needed. In some extreme cases, the region produces *three to four times the total amount of electricity actually being consumed*, placing a strain on the eastern German electric grid. System engineers have to intervene every other day to maintain network stability.

To illustrate the problem that renewable energy instability can cause, here is an example. When the voltage from German's electric grid weakened for just a millisecond at 3 am, the machines at Hydro Aluminum in Hamburg ground to a halt, production stopped, and the aluminum belts snagged, hitting machines and destroying a piece of the mill with damages amounting to $12,300 to the equipment. The

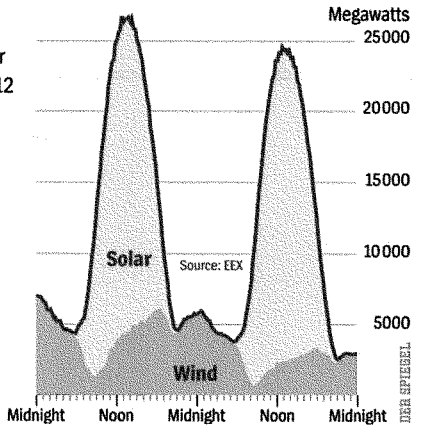
voltage weakened two more times in the next three weeks, causing the company to purchase its own emergency system using batteries, costing $185,000.

These short interruptions to the German electric grid increased by 29 percent and the number of service failures increased 31 percent over a 3-year period, with about half of those failures leading to production stoppages causing damages ranging from ten thousand to *hundreds of thousands* of Euros. These power grid fluctuations in Germany are causing major damage to a number of industrial companies, who have responded by getting their own power generators and regulators to help minimize the risks. However, companies warn that they might be forced to leave if the government does not deal with the issues quickly.

Fluctuating Output

Wind and solar energy fed into the power grid, for example, on May 25 and 26, 2012

In comparison: Net output of the Brokdorf nuclear power plant: 1,410 megawatts

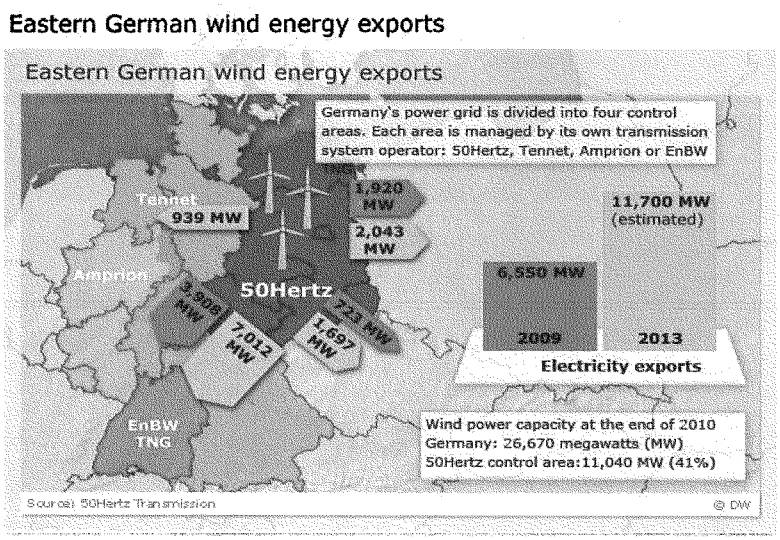


Source: http://www.spiegel.de/international/germany/bild-850419-389683.html

To deal with the excess electricity, eastern Germany exports it to western Germany, Poland and the Czech Republic. In 2009, exports of electricity to these areas totaled 6.5 gigawatts on days with strong winds, an amount that will increase as wind capacity increases. While the eastern German region would like to channel its excess electricity to southern Germany and the industrial Rhineland area, it lacks infrastructure to do so. Because German energy laws stipulate that "green" power must always have priority on the grid, control centers cannot take wind farms off the grid when too much electricity is being generated. System operators also try to avoid shutting down their coal, gas and nuclear facilities because they rely on these power plants to produce a consistent level of baseload power at all times. Thus, they need to export the wind capacity that exceeds their demand.

Germany's neighbors, Poland and the Czech Republic, are taking action on Germany's use of their power grid that Germany undertook without asking permission and without paying for its use. These countries

are building a huge switch-off at their borders to block the import of green energy that is destabilizing their grids and causing potential blackouts in their countries.



Source: http://www.dw.de/wind-energy-surplus-threatens-eastern-german-power-grid/a-14933985

Conclusion

The high use of renewable energy in eastern Germany driven by government green energy policies is causing instability to its own electric grid as well as to neighboring countries, resulting in industrial companies having to purchase generators and emergency back-up systems rather than face replacing equipment damaged during disruptions of service. Electricity bills are also going up by 10 percent this year. With residential electricity prices in Germany already about 3 times higher than prices in the United States and increasing further, it is no wonder that 800,000 German households can't afford their electricity bills.

The German government recently cut its 2013 growth expectations to 0.4 percent from an earlier estimate of 1 percent. Germany was prospering in 2011 with growth at 3 percent, but it dropped to 0.7 percent in 2012. While the European economy as a whole and the switch to the Euro has affected Germany, one wonders how much the country's energy program is contributing.

While renewable energy is increasing its role in electricity generation and energy supply in the United States, its share is still small. In 2012, non-hydroelectric renewable power supplied 5.4 percent of our

electricity in the United States, with wind and solar power combined supplying almost 3.6 percent. In terms of total energy supply, wind and solar power provided a 1.7 percent share in 2012. But Americans are paying for renewable technology development through subsidies, mandates, and failed loan guarantees.

More than half the states have renewable energy standards that mandate a specified share of electricity come from qualified renewable technologies. Both the federal government and state governments provide subsidies and tax breaks to these technologies. And many renewable producers have received grants and loan guarantees from the federal government to spur innovation and production to only have companies go bankrupt, losing billions of taxpayer dollars. So far, increases to utility bills have not been so large that Americans are struggling like those in Germany or other European countries. However, implementation of their policies would likely cause similar results. Americans should beware of policies seeking to duplicate German and other foreign country green energy policies since these countries are quickly reversing their policies as the true costs become evident.

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Malcolm D. Woolf
Senior Vice President, Policy and Government Affairs
Advanced Energy Economy

"Federal Financial Support for Energy Technologies: Assessing Costs and Benefits"

Responses to Follow Up Questions from the U.S. House of Representatives Subcommittee on Energy Science, Space, and Technology Committee

April 11, 2013

1. "Advanced" Energy

Your organization, the Advanced Energy Economy, represents companies engaged in a wide range of activities, including natural gas, energy efficiency, fuel cells, hydro-electric power, energy information technology, etc.

- *What are the common denominators that make these technologies "advanced"?*

AEE defines advanced energy as the best available technologies that are helping to make energy secure, clean and affordable. Advanced energy includes all the technologies listed in the question above, as well as others such as non-hydro renewable energy systems, nuclear power, and hybrid vehicles. Furthermore , advanced energy is not static but dynamic, as innovation and competition produce better energy technologies, products and services over time. Advanced energy includes well-developed technologies and services as well as those at various stages of research, development, demonstration, and commercialization.

AEE's definition of advanced energy is broad by design, and reflects the profound realization that the traditional silos that have separated many energy technologies and markets are fading away. For example, electricity, natural gas, and transportation markets are becoming more intertwined every day, a trend that is likely to continue, driven in large part by advanced energy technologies.

One common denominator linking AEE's member companies is innovation. The century old energy system is facing a fundamental transformation as it meets the internet age, and AEE companies are leading the transformation with new technologies and systems such as smart grid, renewable resources, distributed generation, efficiency and demand response systems and alternative fuel vehicles.

2. *Market Barriers and Failures*

In your testimony you discuss barriers that new energy concepts face in trying to break into the marketplace. But there is a difference between market barriers and market failures. Barriers can be beneficial in that they can ensure that only the most efficient technologies scale-up. But, market failures are imperfections that result in irrational technology choices.

- *Can you elaborate on what companies, such as those that you represent, face – market barriers, failures, or both – and what some of those might be?*
- *Does government money crowd out private investment?*

Innovation is essential to achieving our nation's energy goals, yet it is systematically stymied in the United States by both market failures and market barriers. To achieve secure, clean and affordable energy, the federal government must continue to play a critical, albeit limited role, to help innovative new technologies and services overcome the fundamental failures in the energy market. Let me offer two examples.

First, the legal framework of electric and natural gas utilities creates a powerful disincentive for utilities to innovate. Since the early days of electrification, electric and natural gas utilities have received a guaranteed rate of return as long as their investments were prudent. While this is a sound public policy for keeping the lights on, it is counter-productive if we want to encourage innovation. After all, why should utilities take a risk on unproven, innovative technology when they would receive the same rate of return by using established, existing technologies? When coupled with the institutional inertia that comes from having billions invested in long-lived assets, the legal structure for energy utilities creates a fundamental market failure.

The energy market also suffers from another classic market failure – the inability of the market to capture critical externalities. Environmental externalities, such as the impact of pollution, are well known. The energy sector is plagued, however, with a series of additional externalities, including grid reliability and resiliency, energy security, safety and fuel diversity. Since these externalities are difficult to monetize and reflect in the price of energy, the market systematically undervalues them. For example, the free market may not appropriately value a new technology that is more expensive but makes the system less vulnerable to a cyber attack.

As a result of these market failures, private companies do not spend adequate resources on early-stage research and development (R&D) because the market is unlikely to reward those companies with the returns necessary to justify those investments. My previous testimony cited reports documenting that US energy firms have a chronically low rate of private sector reinvestment.

In addition to these market failures, advanced energy technologies and services also face numerous market barriers such as the lack of access to capital, either for projects or to establish/scale up manufacturing; high capital costs and/or installation costs; consumers that are unfamiliar with the new products or services; and government policies or regulations that can impede or even block market entry.

An example of a market barrier that has been partially addressed by Federal resources is the high first cost of solar photovoltaic (PV) technology. Although PV prices are now declining rapidly, PV's high capital cost has historically put solar power out of reach for most American households. The federal investment tax credit (ITC) for solar has played an important role in making solar leasing a viable business model. With a solar lease, a private company raises capital to install, own, operate and maintain large numbers of residential PV systems. The electricity from each PV system is then sold to the homeowner under a long-term lease or power purchase agreement, typically 20 years. This business model innovation has allowed the private sector to efficiently raise significant capital, and in 2012, leased systems accounted for over 50% of all new residential PV installations in most major residential markets, and is forecasted to become a $5.7 billion market by 2016.[1] This, in turn, is helping the domestic PV industry to grow and capture supply chain efficiencies that is driving down cost and making solar power more affordable overall.

Notwithstanding the remarkable growth of the solar industry, the investments have largely not been made by the incumbant electric utilities (due to the first market failure discussed) nor do investors in these solar projects reap the full benefits of their investment, since externalities such as greater grid reliability, resiliency, energy security, public health, pollution and coincident peak demand production cannot be fully monetized.

Regarding your question about whether or not Federal resources crowd out private sector investment, the data shows that the answer is "no." Considering direct Federal government spending, in Ms. Dinan's testimony (see Figure 3 of her testimony) and in an earlier CBO Issue Brief co-authored by Ms. Dinan,[2] the CBO reported that annual Department of Energy financial support for energy technologies and energy efficiency, with the exception of 2009 (due to ARRA), has been in the range of $2-3 billion per year since the year 1998. In contrast, in 2011, total U.S. revenues associated with the advanced energy market was estimated to be $132 billion.[3] Since the US Energy Department's investments represent only a few percentage points of overall investment dollars, the concern about "crowding out" private investment is clearly misplaced.

In the case of earlier stage investment in R&D, as discussed above, AEE believes that the Federal government actually fills an important gap in the market. Even so, AEE does not believe that this results in Federal investment crowding out private sector investment. Consider the relative size of venture capital investment in "clean-tech" compared to the size of the ARPA-e program budget (Figure 1). Although arguably, ARPA-e invests in companies and technologies that may be too early for even venture capital investment, the scale of the investment shows that Federal government investment is relatively small.

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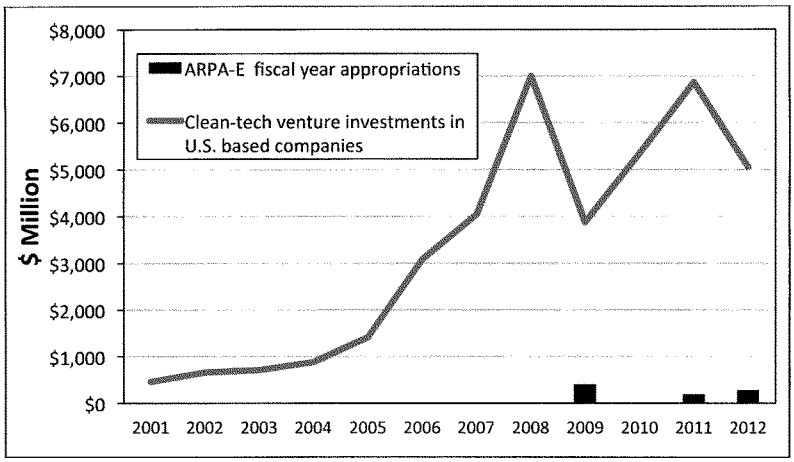
[1] *U.S. Solar Market Insight Report, 2012 Year in Review, Executive Summary*, GTM Research, 2013.
[2] *Federal Financial Support for the Development and, Production of Fuels and Energy Technologies*, Congressional
[2] *Federal Financial Support for the Development and, Production of Fuels and Energy Technologies*, Congressional Budget Office Issue Brief, March 2012.
[3] *Economic Impacts of Advanced Energy: U.S. and Global Market Size, Economic Impact, Tax Revenue Generation, Key Trends, and Representative Companies.* Report prepared by Pike Research, a part of Navigant, for the Advanced Energy Economy Institute, Published 1Q 2013.

Figure 1: Venture capital clean-tech investment in US-based companies compared to ARPA-E appropriations



Sources: CleanEdge, *Clean Energy Trends 2013*, p6; ARPA-E website (http://arpa-e.energy.gov/?q=arpa-e-site-page/arpa-e-budget).

In some cases, such as the ITC for solar discussed above, federal investment can actually help drive significant private sector investment that might otherwise not happen or that might occur at a slower pace. This can be generalized to other Federal tax-related preferences that are designed to encourage private sector investment in energy technologies.

3. Risk

Ms. Hutzler's testimony discusses a range of federal support instruments used in energy, but focuses primarily on recent activities in the clean energy space, and of those, she highlights the problematic ones. While there have been problems with some projects, there have also been tremendous successes. It seems that we, in Congress, give mixed signals to agencies such as DOE in regards to the level and type of risk they are supposed to take on. We want government to invest in areas that industry cannot or will not do on its own because of technological and financial risk. Yet, we are intolerant of failure when it happens.

- *From your perspective, what is the appropriate role of the federal government in supporting energy technology development?*
- *People who invest their money, for example, when saving for retirement, are told to invest in a portfolio of options - stocks, bonds, cash - and within each of those, to be diversified. Are there lessons to be learned here with regard to the U.S. government's role in supporting energy technologies?*

The role of the Federal Government

As stated in my testimony, AEE believes that there is a role for government in situations where there are public benefits that the private sector does not or cannot capture. Within that basic framework, different types of government support are needed to help overcome different technological or market hurdles. For example, direct funding of basic R&D is appropriate for early stage technologies, whereas tax credits or accelerated depreciation are better suited to technologies that are commercially available but must overcome high first costs until the technology and market mature to the point where the technology is competitive on its own.

Whatever, the form of support, AEE believes that the focus should be on promoting innovation to give the United States energy that is secure, clean and affordable. This can include innovation in technologies, products and services, and can address innovation at various stages of the development cycle, from basic R&D to deployment. In support of this, AEE has developed a set of core principles it believes should guide Federal support of advanced energy:

1. Be targeted: limit federal funds to where innovation is needed to build a more secure, clean and affordable energy future. Federal energy programs should only be provided where there is an essential public purpose. Rather than providing permanent support to mature technologies that already have significant market penetration, the federal government's role should be limited to driving innovation and commercializing the next generation of technologies, products and services that promise public benefits. These public benefits include enhancing energy security through fuel diversity and grid modernization, providing cleaner energy that better protects public health, reducing energy costs for consumers and businesses, and developing products that can be competitive in world markets.

2. Sunset or automatically update provisions when market-based objectives are achieved. No company or technology should be entitled to permanent subsidies or investments. For example, when left in place too long, tax incentives distort price and market signals and ultimately create barriers to entry for new technologies. Therefore, such incentives should remain in place only long enough to achieve a measurable, market-based objective (for example, gigawatts installed or share of market) that represents a point at which emerging technologies have reached sufficient maturity that they should stand on their own. Each provision should have an automatic phase-out or periodic update built in from the beginning to send clear signals to businesses and investors.

3. Provide stability and certainty for businesses and investors. Businesses and investors need certainty to make the investments and set the plans necessary to grow. Rules that change frequently or unpredictably are disruptive to markets and harmful to the businesses, investors, and consumers participating in them. Using meaningful, performance metrics tied to maturity in the marketplace, rather than calendar deadlines, to sunset a program or automatically update federal standards would provide certainty to investors, focus businesses on bringing their technologies to scale and moving down the cost curve, and allow market dynamics to drive business success.

4. Be technology neutral to support all forms of advanced technology. Many of today's energy policies were written by Congress with one sector in mind, even favoring a single technology. Such an approach distorts market signals and puts the weight of Congress behind investment decisions. This is inefficient and imposes unnecessary risk to taxpayers. In addition, this approach can inadvertently freeze out next-generation technologies since the best available technology today will not necessarily be the best in the future. Energy R&D programs play an especially critical role in driving the development of next generation technologies. Such programs should be applied as broadly as reasonable to stimulate innovation across technologies, including those that have not yet emerged.

A portfolio approach to Federal support of energy innovation

Regardless of the mix of policy instruments used, AEE also believes it is important that the Federal government maintain a portfolio approach to its support of advanced energy innovation, and that success be measured primarily at the portfolio level. Even the best due diligence on any given investment does not eliminate the risk that the investment may not pan out. ARPA-e is a good example of this, where the investments are focused on high-risk, high-reward technologies, and it is unrealistic for the Federal government to expect that every technology within the ARPA-e portfolio will be a commercial success. In fact, for this type of program it may be appropriate to expect that only a minority of funded projects will ultimately lead to commercial success.

Even where Federal support is focused more on pre-commercial or early-commercial demonstrations, or deployment of commercially-ready technologies, one can and should expect failures. But as long as these failures are within expectations for the type of investment being made, and the overall portfolio performs as expected, one should not "throw the baby out with the bathwater". Where failures do occur, it is appropriate for the Federal government to review them and understand the root causes, so as to better inform future decision-making.

4. Commercial Maturity

Ms. Hutzler's testimony seems to suggest that the current correlation between a technology's commercial maturity and the subsidies it receives is off, and that renewables and efficiency receive an unfair proportion of federal support given their relatively small market share compared to the incumbent technologies. She supports this by saying that solar and wind aren't infant technologies because the first solar cell and electric wind turbines were invented in the late 1800s. But the first oil well was drilled in 1859 and the Natural Gas industry got its start in 1821.

- *Can you talk briefly about the stages that a technology must go through to become mature and commercially viable?*
- *Is the point of federal interventions to pile on more taxpayer funds to those technologies and companies that have already proven to be commercially viable, or is the purpose to create a more diverse energy marketplace by spurring innovations and scale-up in technology areas that have not already benefitted from decades of research and subsidies to help them overcome market barriers and failures?*

The technology development process

The process of taking a technological concept and turning it into a successful business involves many steps, and includes technical, marketing and business aspects.[4] In terms of the technology development process, a new technology must go through the following basic steps in sequence:

- Research and development (component and system levels)
- Initial system prototypes (proof of concept)
- Refined (pre-production) system prototypes
- Commercial demonstrations (validating performance in real-world applications)
- Commercial market introduction (initial commercial sales)
- Market penetration/market maturity (scale-up of the business)

While there are no hard and fast rules, each stage may last from a period of months to years, and possibly even decades for R&D. In general, each stage requires increasing levels of investment as technologies move from laboratory to full-scale manufacturing and deployment.

Regarding the second part of the question, consistent with the core principles set out above, AEE believes that no company or technology should be entitled to permanent subsidies or investments from the Federal government. Such incentives should remain in place only long enough to achieve a measurable, market-based objective that represents a point at which technologies have reached sufficient maturity that they should stand on their own. This suggests that it is appropriate for Federal support to be higher in relative terms (i.e., relative to their market share) for technologies that are less mature, such as wind and solar power (using the examples in the question above), than incumbent technologies, even if the technologies are commercially available today.

5. Government role in developing incumbent techs

While this hearing appears to be scoped to single out federal investments in renewables and efficiency as somehow wasteful by nature, it ignores the role that government has played in research and development of innovation of oil and gas and nuclear technologies. The federal government has spent billions of dollars-- over the span of a century in the case of oil and half a century in the case of nuclear--- investing in researching and developing those technologies that led to industries that now comprise a large portion of the U.S. energy portfolio.

- *Can you explain for this Committee the federal government's role in successfully advancing these technologies? Should we just stop there, and not commit ourselves in a similar fashion to developing other technologies that will pay off in the long-term and help to solve some of our biggest environmental problems?*

[4] For example see the Goldsmith Commercialization Model (http://asbtdc.ualr.edu/technology/commercialization/index.asp)

As noted in my testimony, the Federal government played in important role, over a period of decades, in the development of virtually every major energy sector of our economy. My testimony highlighted the federal government's research to support shale gas going back to 1976, including assessments of the resource base, experiments in directional drilling and hydraulic fracturing techniques. The percentage depletion allowance was created by Congress in 1926 to encourage oil and gas exploration in the western US – and it is still a permanent feature in our tax code. Other examples are provided in the National Research Council report, "Energy Research at DOE: Was It Worth It?"[5]

Similarly, the Federal government played an important role in the development of commercial nuclear power, of which the United States was a pioneer. The boiling water reactor design was developed at Argonne National Laboratory, and the pressurized water reactor was developed initially for naval propulsion.[6] In 1953, President Eisenhower proposed his "Atoms for Peace" program, which reoriented significant research effort towards electricity generation and set the course for civil nuclear energy development in the United States.

These now mature technologies have provided our society tremendous benefits and represented superior solutions over what were the incumbent technologies of the time. We are now faced with new challenges in a new century, including various environmental concerns, maintaining our global competitiveness, and energy security in all its forms. If there are new energy technologies that can help us meet and overcome these challenges, then it seems appropriate that the Federal government has a role in facilitating and accelerating those efforts, where the private sector struggles to do it on its own. This applies to all forms of advanced energy technologies and services, including renewable energy, energy efficiency for our homes, businesses and vehicles, our energy infrastructure, and other technologies that help make our energy system more secure, clean and affordable.

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[5] *"Energy Research at DOE: Was It Worth It?," Energy Efficiency and Fossil Energy Research 1978 to 2000,* Committee on Benefits of DOE R&D on Energy Efficiency and Fossil Energy, Commission on Engineering and Technical Systems, National Research Council.

[6] http://www.world-nuclear.org/info/Current-and-Future-Generation/Outline-History-of-Nuclear-Energy/#.UV2TVpPCZ8E

Appendix 2

Additional Material for the Record

"CHINESE SOLAR APPROACH FACES TEST" FROM *The Wall Street Journal* Online Edition, March 6, 2013

THE WALL STREET JOURNAL.
WSJ.com

BUSINESS | Updated March 6, 2013, 8:17 p.m. ET

Chinese Solar Approach Faces Test

Panel Maker's Bond Deadline Will Show if Aid Continues

By WAYNE MA and CASSANDRA SWEET

A major test of China's promise to consolidate its solar-panel makers looms this month when one of the industry's biggest companies faces a deadline for a steep bond payment.

In December, China's State Council, or cabinet, signaled it would stop funding money-losing domestic solar-panel makers, which are caught up in a global downturn for the industry, and instead encourage mergers among its major companies. It also indicated it would ban local governments from supporting them and allow the market to determine winners and losers.

Bloomberg News

An employee solders strings of solar cells together at the Suntech Power Holdings facility in Goodyear, Ariz., last year.

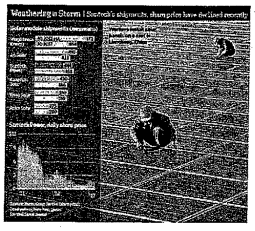
A decision point for this policy shift comes on March 15, when Suntech Power Holdings Co., one of the world's largest solar-panel suppliers, needs to repay more than a half billion dollars of debt held by international investors. The company last reported a net cash position of $244 million as of Aug. 31 and debt of about $2 billion.

Suntech is still in talks with bondholders ahead of the deadline. A Suntech spokesman declined to comment on whether the company would repay the $541 million owed to bondholders.

Suntech said last November it was considering restructuring its foreign debt or making an exchange offer to foreign bondholders. The company said then that "credit support" from Chinese lenders "to repay offshore debt is not available," according to a November presentation for investors. The company said it didn't believe it would be able to issue bonds in China to raise cash and that it didn't have assets it could sell that would raise enough money to pay off its debt.

In December, Suntech said it expected third-quarter revenue would drop by half, to $387 million, compared with a year earlier, and that 2012 shipments of its panels would be less than the company earlier forecast. The company said early

this week that its founder, Zhengrong Shi, stepped down as chairman, less than seven months after he resigned as chief executive. However, Mr. Shi said in a later statement he was improperly removed as chairman and that he was committed to staying.



Amid record-setting pollution in Beijing and other cities and predictions that solar power will be the world's largest primary source of energy in 50 years, China has continued to support its solar industries, even as U.S. and European solar-equipment manufacturers have been forced into restructuring or bankruptcy. Beijing has been sharply critical of antisubsidy and dumping duties slapped on Chinese solar imports by Washington last year. In some cases, Chinese companies have received life support by loans from friendly banks that have helped them restructure debt and by fresh capital from state-backed investors and local governments.

China's 10 largest listed solar companies—including Suntech, Yingli Green Energy Holding Co. and LDK Solar Co. —had combined debt of $17.5 billion at the end of the first quarter of last year, according to U.S.-based investment bank Maxim Group.

In January, LDK said it received a $31 million cash infusion from Chinese investor Fulai Investments Ltd., for about 12% of LDK stock. The solar-wafer company also said it received a loan of 440 million yuan ($70.5 million) from China Development Bank in January to upgrade a polysilicon plant.

Still, domestic support for Chinese companies may not last. Chen Yuan, chairman of China Development Bank, said Tuesday on the sidelines of China's annual session of parliament that the bank would limit fresh lending to solar-panel companies. CDB's credit exposure to China's solar sector was more than $7 billion in 2011, by far the largest among Chinese state-owned banks, according to ChinaScope Financial, a data provider.

Meanwhile, with its weak balance sheet, Wuxi, China-based Suntech, whose American depositary receipts trade in New York, faces the prospect of having to make the $541 million bond payment due March 15 on its own.

The industry's debt grew rapidly between 2009 and 2011 to fund a rapid expansion of manufacturing capacity. Although global solar-power demand has grown each year, it hasn't kept pace with the manufacturing boom, causing solar-panel makers to cut costs and write down investments while they hunt for new markets. European demand in particular has been hit by the EU's economic crisis and the rolling back of clean-energy subsidies.

Although the Chinese government will likely provide financial help to keep Suntech's factories operating and its workers employed, it is unclear whether China would "bail out American investors who simply got into the wrong company," said Pavel Molchanov, an analyst at Raymond James Associates in New York.

Mr. Molchanov predicted that Suntech will have to restructure its debt and that shareholders will end up with little or nothing.

In the event of a debt restructure, bondholders likely would be offered a bond with a longer

maturity and an equity stake in the company, Mr. Molchanov said. Such a deal could lead to a doubling of Suntech's share count, which would cut existing investors' equity ownership by half. And if Suntech stock fell below $1 again, as it did for much of last year, existing shareholders could lose most of their investment, he said.

The Suntech bonds coming due March 15 traded Wednesday at $40 per $100 of the bonds' original value, according to e-trading platform MarketAxess. When corporate bonds trade at such low, or distressed, levels, it implies a default is likely. But bondholders have a senior unsecured claim on the company's assets and some specialty-funds could purchase the bonds in the hopes of receiving a higher recovery rate than the current market value, which is 40 cents on the dollar, or roughly $216 million of the $541 million owed.

Most of Suntech's foreign bondholders are specialty shops or distressed funds, according to Ipreo, a data firm. Mount Kellett Capital Management was the top foreign bondholder, with about $26 million worth of Suntech convertible notes, according to Ipreo. Mount Kellett declined to comment on the bonds. Other top holders included Driehaus Capital Management, Pioneer Investment Management and Silverback Asset Management. Those firms also declined to comment.

The bonds are a type of debt known as convertible notes, which enable investors to convert the bonds into stock at a predetermined price. For these bonds, that price is $41 a share. Suntech shares closed Wednesday in New York at $1.18, down about 20% year-to-date, making the conversion component of the bonds worthless to investors.

Last year, Suntech and several Chinese solar companies whose American depositary receipts are traded in New York were told they could be delisted due to the collapse in their share prices to below $1. Since then, most have climbed out of the danger zone, and Suntech last month reported that its stock price had also climbed above the NYSE's minimum $1 requirement over a 30-day average.

Suntech's March 15 debt payment marks the first time a Chinese solar firm has been under pressure to pay foreign creditors, said Nitin Kumar, an analyst at Nomura Holdings Inc. Although Chinese creditors have tended to be more forgiving about repayment schedules and terms, foreign bondholders may be less willing, Mr. Kumar said. "It might simply be too big of a bullet to bite." Mr. Kumar said he expects Suntech will reach an agreement with U.S. creditors, with the Chinese government possibly acting as a backstop against failure.

Beijing is offering indirect help to solar companies in the form of new policies and incentives for solar-power development and to boost demand for panels. That is in line with the government's plan to have clean energy account for 11.4% of power consumption by 2015 while trimming pollution from coal-fired power stations, which now generate about 70% of the country's electricity.

—Patrick McGee contributed to this article.

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A version of this article appeared March 7, 2013, on page B10 in the U.S. edition of The Wall Street Journal, with the headline: Chinese Solar Approach Faces Test.

"BJORN LOMBORG: GREEN CARS HAVE A DIRTY LITTLE SECRET" FROM *The Wall Street Journal* Online Edition, March 11, 2013

THE WALL STREET JOURNAL.
WSJ.com

OPINION | Updated March 11, 2013, 10:14 a.m. ET

Bjorn Lomborg: Green Cars Have a Dirty Little Secret

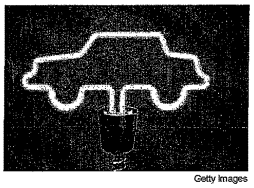
Producing and charging electric cars means heavy carbon-dioxide emissions.

By Bjorn Lomborg

Electric cars are promoted as the chic harbinger of an environmentally benign future. Ads assure us of "zero emissions," and President Obama has promised a million on the road by 2015. With sales for 2012 coming in at about 50,000, that million-car figure is a pipe dream. Consumers remain wary of the cars' limited range, higher price and the logistics of battery-charging. But for those who do own an electric car, at least there is the consolation that it's truly green, right? Not really.

For proponents such as the actor and activist Leonardo DiCaprio, the main argument is that their electric cars—whether it's a $100,000 Fisker Karma (Mr. DiCaprio's ride) or a $28,000 Nissan Leaf—don't contribute to global warming. And, sure, electric cars don't emit carbon-dioxide on the road. But the energy used for their manufacture and continual battery charges certainly does—far more than most people realize.

A 2012 comprehensive life-cycle analysis in Journal of Industrial Ecology shows that almost half the lifetime carbon-dioxide emissions from an electric car come from the energy used to produce the car, especially the battery. The mining of lithium, for instance, is a less than green activity. By contrast, the manufacture of a gas-powered car accounts for 17% of its lifetime carbon-dioxide emissions. When an electric car rolls off the production line, it has already been responsible for 30,000 pounds of carbon-dioxide emission. The amount for making a conventional car: 14,000 pounds.



Getty Images

While electric-car owners may cruise around feeling virtuous, they still recharge using electricity overwhelmingly produced with fossil fuels. Thus, the life-cycle analysis shows that for every mile driven, the average electric car indirectly emits about six ounces of carbon-dioxide. This is still a lot better than a similar-size conventional car, which emits about 12 ounces per mile. But remember, the production of the electric car has already resulted in sizeable emissions—the equivalent of 80,000 miles of travel in the vehicle.

So unless the electric car is driven *a lot*, it will never get ahead environmentally. And that turns out to be a challenge. Consider the Nissan Leaf. It has only a 73-mile range per charge. Drivers attempting long road trips, as in one BBC test drive, have reported that recharging takes so long that the average speed is close to six miles per hour—a bit faster than your average jogger.

Related Video

Charlie Drevna, president of the American Fuel & Petrochemical Manufacturers, on how Washington's fuel standards are increasing the price of cars and gas. Photos: Associated Press

To make matters worse, the batteries in electric cars fade with time, just as they do in a cellphone. Nissan estimates that after five years, the less effective batteries in a typical Leaf bring the range down to 55 miles. As the MIT Technology Review cautioned last year: "Don't Drive Your Nissan Leaf Too Much."

If a typical electric car is driven 50,000 miles over its lifetime, the huge initial emissions from its manufacture means the car will actually have put more carbon-dioxide in the atmosphere than a similar-size gasoline-powered car driven the same number of miles. Similarly, if the energy used to recharge the electric car comes mostly from coal-fired power plants, it will be responsible for the emission of almost 15 ounces of carbon-dioxide for every one of the 50,000 miles it is driven—three ounces more than a similar gas-powered car.

Even if the electric car is driven for 90,000 miles and the owner stays away from coal-powered electricity, the car will cause just 24% less carbon-dioxide emission than its gas-powered cousin. This is a far cry from "zero emissions." Over its entire lifetime, the electric car will be responsible for 8.7 tons of carbon dioxide less than the average conventional car.

Those 8.7 tons may sound like a considerable amount, but it's not. The current best estimate of the global warming damage of an extra ton of carbon-dioxide is about $5. This means an optimistic assessment of the avoided carbon-dioxide associated with an electric car will allow the owner to spare the world about $44 in climate damage. On the European emissions market, credit for 8.7 tons of carbon-dioxide costs $48.

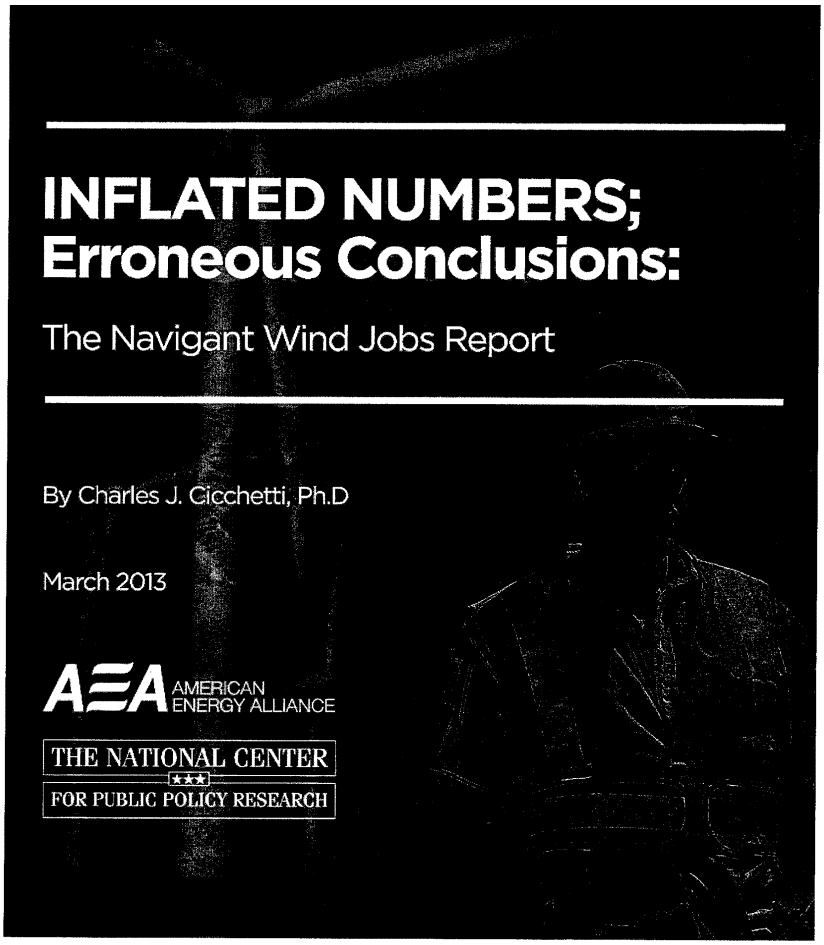
Yet the U.S. federal government essentially subsidizes electric-car buyers with up to $7,500. In addition, more than $5.5 billion in federal grants and loans go directly to battery and electric-car manufacturers like California-based Fisker Automotive and Tesla Motors . This is a very poor deal for taxpayers.

The electric car might be great in a couple of decades but as a way to tackle global warming now it does virtually nothing. The real challenge is to get green energy that is cheaper than fossil fuels. That requires heavy investment in green research and development. Spending instead on subsidizing electric cars is putting the cart before the horse, and an inconvenient and expensive cart at that.

Mr. Lomborg, director of the Copenhagen Consensus Center in Washington, D.C., is the author of "The Skeptical Environmentalist" (Cambridge Press, 2001) and "Cool It" (Knopf, 2007).

A version of this article appeared March 11, 2013, on page A15 in the U.S. edition of The Wall Street Journal, with the headline: Green Cars Have a Dirty Little Secret.

"INFLATED NUMBERS; ERRONEOUS CONCLUSIONS: THE NAVIGANT WIND JOBS REPORT" BY CHARLES J. CICCHETTI, PH.D., MARCH 2013



ABOUT

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Dr. Charles J. Cicchetti held the Jeffrey and Paula Miller Chair in Government, Business, and the Economy at the University of Southern California until 2008. He continues to lecture at USC on electricity matters. Cicchetti was the Deputy Director of the Energy and Environmental Policy Center at Harvard University's John F. Kennedy School of Government. He was Professor of Economics and Environmental Studies at the University of Wisconsin, Madison from 1972 to 1985. He was the first economist at the Environmental Defense Fund and did post-doctoral research at Resources for the Future.

Dr. Cicchetti also chaired the Wisconsin Public Service Commission from 1977 to 1980 and previously directed the Wisconsin Energy Office. He was a member of the California ISO Market Advisory Group. He is an economic consultant and a Senior Advisor to Pacific Economics Group and others. He has been associated and held management positions in the past with Arthur Andersen Economic Consulting, Putnam Hayes and Bartlett, NERA, and Madison Consulting Group.

His publications include Going Green and Getting Regulation Right, The California Electricity Crisis, Restructuring Electricity Markets, Perspectives on Power, The Marginal Cost and Pricing of Electricity, and Alaskan Oil.

The American Energy Alliance

Founded in May 2008, the American Energy Alliance (AEA) is a not-for-profit organization that engages in grassroots public policy advocacy and debate concerning energy and environmental policies. AEA believes that freely-functioning energy markets provide the most efficient and effective solutions to today's global energy and environmental challenges and, as such, are critical to the well-being of individuals and society. AEA believes that government policies should be predictable, simple and technology neutral.

The National Center for Public Policy Research

The National Center for Public Policy Research (NCPPR) is a not-for-profit communications and research foundation supportive of a strong national defense and dedicated to providing free market solutions to today's many public policy problems. Founded in 1982, NCPPR has provided top-flight research and communications operations for more than three decades, earning a solid reputation for its defense of private land ownership, sound energy and economic policies, and conservative approaches to regulatory reform. The National Center has never requested nor received funding from the federal government nor any state nor foreign government.

EXECUTIVE SUMMARY

In December 2011, Navigant Consulting, Inc., produced a Report substantially based on American Wind Energy Association (AWEA) assumptions.[1] This Report purports to evaluate and compare two wind Production Tax Credit (PTC) expiration scenarios (Scenario 1, without extending the PTC; Scenario 2 with the PTC). For each, Navigant estimated installed wind capacity and jobs. AWEA and its supporters have repeatedly used the Report's claim of 37,000 potential lost jobs in 2013 as a key reason to extend the wind PTC.[2] Using energy policy to formulate a national jobs policy is not efficient, cost effective, or sensible, especially when picking generation "winners" by providing extraordinarily expensive subsidies like the PTC.[3]

But most significantly, the Report's data, calculations, and resulting wind capacity and job loss estimates are not credible and should not be relied upon to support further extension of the PTC.

In particular, the Report vastly overstates potential jobs losses without the PTC because it: (1) relies on biased, inflated wind capacity forecasts; (2) incorrectly applies economic models; and (3) fails to consider job creation opportunities from building other generation sources instead of wind. In fact, following Navigant's methodology, building conventional generating capacity results in even greater job creation than building more wind. Nevertheless, basing energy policy on the number of jobs created by building generation facilities is economically wasteful. The choice of generation alternatives should focus on establishing policies that create cost-effective, affordable, and reliable electricity.

The Report's Wind Capacity And Jobs Numbers Are Grossly Inflated

- Navigant erroneously calculated PTC-related job losses ignoring contrary federal government data, and instead used the wind industry's self-serving, inflated forecasts for wind capacity. Navigant forecasts 20,200 MWs of additional wind capacity with a 4-year extension of the PTC, relative even to its also inflated base case. The Navigant forecasts with and without the PTC extension exceed the government's reference 2016 forecasts by 20% and 55%, respectively.

- Navigant incorrectly applied the Jobs and Economic Development Impact (JEDI) economic model. Replicating Navigant's work for five important wind states (California, Texas, Iowa, Illinois, and Pennsylvania) demonstrates that through this error alone, Navigant overstates potential job losses by at least 100%.

- Navigant also incorrectly applied the Impact Analysis For Planning (IMPLAN) economic model, using questionable multipliers to add indirect and induced jobs, which further overstates potential job losses by at least another 72%.

Overall Jobs Will Increase, Not Decrease, By Using Alternatives To Wind Generation

Navigant's inflated numbers are further distorted because Navigant estimated the incremental wind capacity that would be built because of the PTC and then fed those capacity numbers into the economic models. Navigant's flawed methodology presents only a fraction of the true economic story. Wind is not a particularly reliable or dependable source of energy. Adding 20,200 MWs of wind does not translate into the same amount of reliable electricity capacity, capable of replacing on a MW-for-MW basis an equal amount of conventional existing nuclear or fossil-fired generation. Accordingly, no one should think that a MW of new wind generation could replace an existing MW of nuclear or coal generation. The importance of distinguishing between the availability and utilization of different types of generating capacity should not be ignored.

Navigant's job creation methodology never asks: "Compared to what?" Wind is not the only choice. Navigant never compares wind's job impact to the jobs created using other types of electricity generating capacity. This unreasonably ignores two important considerations. Second, if 20,200 MWs[4] of generating capacity were actually needed, based on Navigant's own methodology, alternative generation and plant life-extensions would add more jobs than wind.

The Report poses the wrong question. The appropriate question is the impact of the wind PTC's extension on the overall economy, a question answered by focusing on cost-effective and reliable resources that could be built instead of wind.[5] The reality is that wind generation is much less available than other electricity generation resources. Alternative electricity generation types also typically employ more direct jobs per MW of installed capacity. Therefore, for the same MWs of added capacity, other forms of generation would actually increase direct jobs.

- Assuming wind could replace other electricity generation resources on a MW-for-MW basis is incorrect. However, if the choice is viewed as how many jobs will be added when electricity capacity additions are being evaluated, there would be many more jobs added using other generation resources.

- Using Navigant's previous work, published in *Public Utilities Fortnightly (PUF)*, to determine local direct permanent jobs shows that operating other forms of generation would result in more jobs than operating similar amounts of wind generation.

- A one-year PTC extension could cost up to $4.8 million for each direct wind manufacturing and construction job added. Worse, costly uneconomic subsidies that increase retail electricity prices reduce U.S. competiveness and reduce job creation in the overall economy.

As highlighted above, Navigant's fatally flawed Report on the impact of the wind PTC expiration is based on self-serving industry interviews and unsupported wind capacity forecasts that have no credibility. Therefore the Report's resulting job loss numbers are meaningless and should not be used to justify spending billions of dollars in taxpayer money to extend an unneeded subsidy for the wind industry. On the contrary, if the rationale for PTC extension is based on creating jobs in the overall economy, the reality is that other generating technologies would create more direct jobs for the same amount of added capacity than wind power would create.

1 Navigant Consulting, *Impact of the Production Tax Credit on the U.S. Wind Market*, December 11, 2011. Hereafter, "the Report." Available at: http://www.awea.org/learnabout/publications/reports/upload/AWEA-PTC-study-121211-2pm.pdf

2 *See*, AWEA Press Release http://awea.org/newsroom/pressreleases/officialyearendnumbersreleased.cfm; http://www.awea.org/newsroom/pressreleases/Layoffs_wind_power.cfm; http://cleantechnica.com/2012/12/13/wind-tax-credit-awea-is-up-for-a-6-year-phase-out/; http://www.westgov.org/index.php?option=com_content&view=article&id=428:ptc-letter-to-congress&catid=261; http://news.yahoo.com/wind-energy-tax-credit-survives-fiscal-cliff-230400967.html

3 The Congressional Joint Committee on Taxation estimated a one-year extension of the PTC would cost $12.1 billion. *See*, Joint Committee on Taxation, estimate of Senate Finance Committee's tax-extender bills, JCX-70-12, August 2, 2012. Available at: https://www.jct.gov/publications.html?func=download&id=4482&chk=4482 &no_html=1. Moreover, wind generation is intermittent and unreliable, because the wind often fails to blow when demand is greatest, making wind a less desirable generation source when compared to both conventional and other renewable generation sources.

4 Difference between Scenario 1 and Scenario 2. Report, p. 13.

5 Donald Harker and Peter Hans Hirschboeck, "Green Job Realities – Quantifying the Economic Benefits of Generation Alternatives," *Public Utilities Fortnightly*, May 2010. Available at: http://www.fortnightly.com/fortnightly/2010/05/green-job-realities.

INTRODUCTION

In December 2011, Navigant issued a report entitled *Impact of the Production Tax Credit on the U.S. Wind Market*, which concluded in pertinent part that if the wind PTC were not extended for four more years there would be: (1) nearly 75% fewer annual additions of wind capacity in 2013;[6] and (2) about half as many, or 37,000 fewer, wind-related jobs in 2013.[7]

The Report, however, is fatally flawed, because unsupported and erroneous assumptions, not facts, drive its predicted dire outcomes. Without detailing its methodology, the Report claims to apply the JEDI and IMPLAN models to calculate the capacity and jobs impacts of a wind PTC expiration, but it relies on incorrectly utilized JEDI/IMPLAN models, proprietary data, and likely biased, unreliable interviews to drive the models' results. Simply put, biased and erroneous inputs make any modeling results meaningless.

First, the Report based its job loss numbers on self-serving industry wind capacity forecasts that far exceed impartial government forecasts. Second, the Report incorrectly applied the JEDI model, an error that alone overstated claimed job losses by at least 100% in the key states that were reviewed.

Third, the Report applied the IMPLAN model by using questionable multipliers to add indirect and induced jobs, which overstated job losses by at least another 72%. Lastly, the Report told only half the story, choosing to ignore the reality that wind by its nature is not a reliable source of electricity generation capacity. Furthermore, other forms of electricity generation would create many more direct operating, construction, and manufacturing jobs for each additional MW of installed capacity.[8]

This is not to say that the nation's electricity generation decisions should be based on which source of electricity generation creates the most jobs per MW of installed capacity. Goals such as economic efficiency, productivity, and grid reliability are all arguably much more important considerations. The Report, however, has been used to justify the PTC based on exaggerated and misleading claims of more jobs when, other things equal, wind capacity expands. The inconvenient truth for the wind industry is that other generating technologies produce more American direct operating, construction and manufacturing jobs than wind power per unit of installed capacity.

6 Report, p. 13.

7 Report p. 24.

8 The Committee on Energy and Commerce issued a June 18, 2012, memorandum that focused on job creation resulting from Section 1603 of the American Reinvestment and Recovery Act (the Recovery Act or "stimulus")—a grant program administered by the Department of Treasury (Treasury) and the Department of Energy (DOE) that offered cash payments to renewable energy projects, mainly solar and wind. The memorandum concluded, among other things, that besides overstating the number of jobs created by Section 1603 grants, the National Renewable Energy Laboratory's (NREL) models do not account for displaced jobs, economic activity related to changes in utilization of existing power plants, electric utility revenues, and household and business energy expenditures. The NREL study does not estimate job creation and economic impacts associated with possible alternative spending of federal funds. To date, over $10 billion have been awarded to wind projects under this recently expired program.

THE REPORT'S WIND CAPACITY AND JOBS NUMBERS ARE GROSSLY INFLATED

The Report Vastly Overstates Wind Capacity "Lost" Without the PTC

Navigant vastly overstates wind capacity "lost" without a PTC extension, claiming 20,200 MWs of wind capacity would not be installed through 2016.[9] Navigant, however, derived this inflated number from two unsupported forecasts that were rife with made-up numbers. Most notably, both of Navigant's capacity forecasts are substantially higher than the U.S. government's Energy Information Administration's (EIA) impartial, objective wind capacity forecasts, which, inexplicably, Navigant ignores.

Navigant's Scenario 1 forecast asserts that without the PTC about 70,000 MWs of wind would be installed through 2016.[10] Its Scenario 2 forecast claims that, with a four-year extension of the PTC, about 90,000 MWs would be installed through 2016. Both forecasts rely upon unscientific and likely biased interviews with 24 wind anufacturers and developers.[11] Wind developers and manufacturers clearly have a vested interest in extending the PTC, and thus in conclusions that rely on their self-serving projections. The Report's methodology is analogous to asking the head of advanced ticket sales how well the home team will perform next season. The 20,200 MW difference between the two inflated forecasts constitutes the claimed MWs "lost" without a PTC extension.

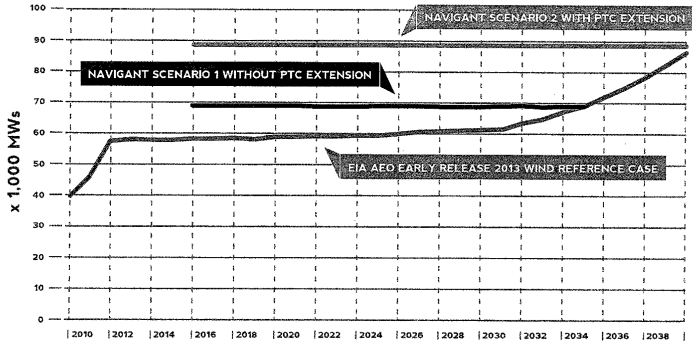
Both scenarios start with about 55,000 MWs[12] of installed wind capacity in 2012 and show annual forecasts and growth over the next four years (through 2016).[13] But the Report fails to explain the year-over-year capacity variations for the two scenarios. Most significantly, these unexplained annual capacity variations differ markedly from the federal government's comprehensive EIA energy forecasts covering multiple underlying assumptions and economic conditions.

In both of the Report's scenarios, projected annual wind capacity growth rates never match any of EIA's year-over-year projections. Rather, EIA's 2013 forecast for wind capacity, as reported in its impartial Annual Energy Outlook (AEO), and as shown in Chart 1, differs greatly from the Report's vastly inflated forecasts.[14] Chart 1 shows EIA's 2013 AEO Early Release Reference Case and where Navigant's Scenarios 1 and 2 for 2016 actually intersect with EIA's forecasts. In stark contrast to the Report's forecasts that without the PTC about 70,000 MWs of wind capacity would be installed through 2016, and with the PTC about 90,000 MWs, EIA's AEO Early Release (2013) Reference Case[15] forecast of wind capacity for 2016 is only 58,080 MWs, and that remains relatively constant through 2030. In fact, the Report's Scenario 1 forecast for 2016 does not intersect with EIA's forecast until about 2035, or almost 20 years later. The Report's Scenario 2 forecast for 2016 does not even come close to EIA's forecast until 2040 and never intersects it.

The Report forecasts that without the PTC extension about 70,000 MWs of wind capacity would be installed about 20 years earlier than EIA's forecast (i.e., by 2016), and with the PTC about 90,000 MWs would be installed by 2016. Navigant's forecast that 70,000 MWs of wind capacity would be installed through 2016 without the four-year PTC extension is 20 percent higher than EIA's reference case forecast of 58,080 MWs, and its forecast that 90,000 MWs of wind capacity would be installed through 2016 with the PTC extension is 55% higher than EIA's reference forecast.

CHART 1

EIA AEO 2013 EARLY RELEASE NET SUMMARY CAPACITY WIND REFERENCE CASE VERSUS NAVIGANT SCENARIOS 1 AND 2



The Report Vastly Overstates PTC-Related Job Losses

The Report applies its grossly inflated PTC- related wind capacity numbers to calculate its claimed jobs numbers. The Report also incorrectly applies the economic models it uses, compounding the job number errors.

For example, the JEDI model is too narrow for Navigant's attempted broad national economic analysis as it is an individual-power-plant model, which, at best, addresses small generation unit additions within the electricity industry. Erroneously applying JEDI, the Report fails to consider the employment effects of expanded or reduced wind capacity throughout the economy. In other words, the Report fails to consider the job impacts of other generating technologies when determining the job losses due to not constructing 20,200 MWs of wind capacity, assuming that amount of capacity would actually be required.[16] Rather, the Report asserted that over five years, a PTC extension would create an additional 169,000 wind-related jobs from the claimed incremental 20,200 MWs, or 8.4 jobs per MW of wind (169,000 jobs ÷ 20,200 MWs).[17] However, correctly applying the JEDI model, as shown in Appendix A, would produce only 2,110 jobs (2,033 direct, indirect, and induced manufacturing and construction jobs, plus 77 operations jobs) for a 500 MW wind plant, or just 4.2 jobs per MW of wind (2,110 jobs ÷ 500 MWs). Thus, through this error alone, the Report erroneously overstated PTC-related jobs, and concomitantly job losses, by at least 100% (8.4 jobs per MW versus the correct 4.2 jobs per MW).

To reach the purported 169,000 "total" wind-related jobs over five years, the Report applies multipliers to estimate indirect jobs (i.e., downstream suppliers) and induced jobs (i.e., from the spending of direct and indirect workers). For each direct manufacturing job, the Report adds about 1.7 indirect jobs and almost one induced job (0.9); for each direct construction or operation and maintenance job, it adds more than 5 indirect and induced jobs.[18] Applying these questionable multipliers and adding the indirect and induced jobs to the direct jobs further inflates purported wind-related jobs, and concomitantly any potential job losses, by at least 72% [1-(47 direct jobs ÷ 169 total jobs)].

9 Report, p. 7.

10 Report, p. 13.

11 Report, p. 12.

12 In a recent press release, AWEA claims that as of December 13, 2012, the wind industry had achieved 60,000 MWs of cumulative installed wind capacity. For the purposes of this paper, we utilize 55,000 MWs of installed capacity to accurately reflect the installed capacity projections at the time Navigant conducted its analysis. http://awea.org/newsroom/pressreleases/officialyearendnumbersreleased.cfm

13 Report, p. 13.

14 See EIA, AEO 2013 Early Release, http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2013ER &subject=10-AEO2013ER&table=16-AEO2013ER&region=0-0&cases=early2013-d102312a

15 The EIA states: "The *AEO2013* Reference Case generally assumes that current laws and regulations affecting the energy sector remain unchanged throughout the projection (including the implication that laws that include sunset dates do, in fact, end at the time of those sunset dates)." See page 2 of the EIA's AEO 2013 Early Release Overview. Available at: http://www.eia.gov/forecasts/aeo/er/index.cfm

16 The Congressional Research Service (CRS) and the *Wall Street Journal* highlighted the tremendous variability in estimates of temporary and permanent jobs spawned by the Section 1603 grant program. *See*, Phillip Brown and Molly F. Sherlock, *ARRA Section 1603 Grants in Lieu of Tax Credits for Renewable Energy: Overview, Analysis, and Policy Options*, February 8, 2011, p. 24 n15, Available at http://assets.opencrs.com/rpts/R41635_20110208.pdf. See also, Ianthe Jeanne Dugan and Justin Scheck, "Cost of $10 Billion Stimulus Easier to Tally Than New Jobs," Wall Street Journal, February 24, 2012. Available at: http://online.wsj.com/article/ SB10001424052970203710704577050412494713178.html. Those reports suggested a paltry record of long-term job creation. CRS noted that "the potential for job creation has become a key factor in evaluating renewable energy investment incentives and programs" but that "despite being an issue of importance, quantifying and measuring green job creation and growth has been difficult" and added that "it is recommended that any job creation estimate be viewed with skepticism." In support of these statement, Brown and Sherlock cited Richard J. Campbell and Linda Levine, *Renewable Energy—A Pathway to Green Jobs?* CRS Report R40833, September 24, 2009.

17 The Report claims 501,000 total wind jobs with the PTC extension and 333,000 total wind jobs without the PTC extension. The difference (501,000 – 333,000) equals the 169,000 "lost" jobs the Report claims without the PTC extension. This estimate does not correctly use the JEDI/IMPLAN method; it also includes questionable assumptions about indirect and induced jobs. *See*, Report, p. 24.

18 An important aspect of the manufacturing jobs touted in the Report is that many of these jobs are likely to be located outside of the United States. For example, the U.S. House of Representatives Committee on Energy and Commerce reported: "At the end of 2010, nine of the top-ten global wind turbine suppliers were headquartered outside the U.S." H.R. Comm. on Energy and Commerce, The Policy Paper Series, Vol. 2, Issue 1, Majority Staff Report, January 17, 2013. *American Taxpayer Investment, Foreign Corporation Benefit: Foreign Corporations Have Received Approximately One-Quarter of $16 Billion Spent on "Section 1603" Renewable Energy Stimulus Program*. Available at: http://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/ files/analysis/20130117foreigninvestment.pdf.

INCREASING WIND CAPACITY COSTS AMERICAN JOBS

Additional major flaws further distort and inflate the Report's job loss numbers. The analysis narrowly focuses on wind industry jobs without considering jobs from other electricity generation technologies.[19] Wind generation is only one technology used to supply electricity to the nation. The Report ignores the complex and highly interdependent aspects of the electricity industry.[20] The electric power industry primarily adds new capacity to meet growing demand or to replace older, less efficient, and more costly generation. Therefore, it is not reasonable or legitimate to attempt to estimate the PTC's impact on jobs without analyzing the jobs related to alternative generation options.

Furthermore, using energy policy to create jobs is inefficient and often embraces major conflicting economic objectives. Rather, increased productivity and reliability and the effect of generation capacity costs on consumers are much more important considerations.

Nonetheless, in purporting to assess the jobs impact, the Report's focus should have been the U.S. economy and jobs, not just wind jobs. The Report's one-sided, incomplete analysis unreasonably fails to consider how a PTC extension would reduce other interdependent electricity generation sectors. Credible numbers require unbiased and complete analysis that considers and measures every interdependent segment of the electric power industry and nets any partial losses in one segment against any gains in others.

Notably, in an article published in *Public Utilities Fortnightly* in May 2010, Navigant reported that wind produces fewer operating jobs than other types of generating capacity.[21] As restated below in Table 1, this analysis compared the direct, local, essentially permanent, operating jobs for different types of installed electricity generation on a capacity basis.

TABLE 1

LOCAL DIRECT OPERATING JOBS

TECHNOLOGY	AVERAGE SIZE (MW)	DIRECT LOCAL JOBS	DIRECT LOCAL JOBS NORMALIZED FOR 1,000 MW
NUCLEAR	1,000	504	504
COAL	1,000	187	187
HYDRO >500 MW	1,375	156	113
HYDRO PUMPED STORAGE	890	85	96
HYDRO >20 MW	450	86	191
CSP	100	47	470
COMBINED CYCLE	630	34	54
PV	10	11	1100
MICRO HYDRO <20MW	10	5	500
WIND	75	4	53

SOURCE: HARKER, DONALD AND PETER HANS HIRSCHBOECK.
"GREEN JOB REALITIES: QUANTIFYING THE ECONOMIC BENEFITS OF GENERATION ALTERNATIVES"
FIGURE 2, PAGE 32. PUBLIC UTILITY FORTNIGHTLY. MAY 2010

Navigant's vetted *PUF* paper demonstrates that all other generating alternatives considered would have more direct local jobs than wind generation per MW of installed capacity.

Table 2 shows the estimated direct—as well as the combined direct, indirect, and induced—manufacturing and construction jobs for three different generating sources (coal, natural gas, and wind) based on the models that Navigant used. These estimates are shown in Appendix A and were based on coal, natural gas, and wind generation JEDI/IMPLAN analyses in major wind states (California, Illinois, Iowa, Pennsylvania, and Texas).

Table 2 shows that a 500 MW wind generation plant would add 250 direct up-front construction and manufacturing jobs, or 10,100 up-front direct construction and manufacturing jobs for 20,200 MWs. The corresponding upfront jobs for natural gas and coal are 1,821 jobs per 500 MW of additional capacity, or 73,589 jobs assuming 20,200 MWs of needed capacity. Despite the previous criticisms of Navigant's methods and assumptions, it is important to understand that correctly using Navigant's JEDI/IMPLAN method to estimate the jobs related to additional installed generating capacity demonstrates that other generation types would produce about 63,500 more direct operating, manufacturing, and construction jobs for 20,200 MWs of capacity than an "assumed" 20,200 MWs of wind would. (Note: This calculation is based on treating wind capacity and fossil fuel capacity as producing the same amount of electricity per unit of capacity. Of course, this is not the case, given that wind power generates a lot less electricity than fossil fuel generating technologies for the same amount of capacity, due to its intermittency.)

Under any circumstances, however, using energy policy to create jobs is inefficient, and is even worse when policy attempts to pick the "winners" as it does with the PTC. Rather than continuing to subsidize wind with the expensive PTC, if additional generation resources are needed the more economic approach would be for providers to invest to extend the life of nuclear and hydroelectric facilities, reduce pollution at coal-fired units, and build conventional generation.

The Congressional Joint Committee on Taxation, for example, has estimated that the cost of a one-year PTC extension is $12.1 billion.[22] Thus, even accepting the Report's grossly inflated number of 37,000 wind jobs, the cost to the American taxpayers would be $12.1 billion divided by 37,000, or about $327,000 per job.[23] But the Report's job numbers are vastly overstated. Therefore, the actual wind-related job cost would be far greater. For example, using Navigant's claim of 20,200

TABLE 2

JEDI TOTAL JOBS IN MANUFACTURING AND CONSTRUCTION FOR DIRECT, INDIRECT, AND INDUCED CATEGORIES BASED ON 500 MWs OF INSTALLED CAPACITY

	COAL		NATURAL GAS		WIND	
	DIRECT CONSTRUCTION & MANUFACTURING	DIRECT, INDIRECT, AND INDUCED CONSTRUCTION & MANUFACTURING	DIRECT CONSTRUCTION & MANUFACTURING	DIRECT, INDIRECT, AND INDUCED CONSTRUCTION & MANUFACTURING	DIRECT CONSTRUCTION & MANUFACTURING	DIRECT, INDIRECT, AND INDUCED CONSTRUCTION & MANUFACTURING
CALIFORNIA	2,732	5,104	607	1,566	249	1,954
TEXAS	3,101	5,368	705	1,621	252	2,038
IOWA	3,395	5,450	753	1,621	258	2,073
ILLINOIS	2,688	5,054	632	1,581	244	2,003
PENNSYLVANIA	2,917	5,415	681	1,672	274	2,095
AVERAGE	2,967	5,278	676	1,612	250	2,033

MWs less wind generation without the PTC would mean an average of about 5,050 MWs per year difference over the 2013–2016 period. The JEDI/IMPLAN method shows 250 direct up-front manufacturing and construction wind-related jobs per 500 MWs, which would mean 2,525 up-front direct jobs for 5,050 MWs per year. Therefore, the cost for a one-year PTC extension could be as much as a staggering $4,792,079 per direct up-front job added ($12.1 billion ÷ 2,525 jobs).[24]

19 Another important point about job creation is that the PTC is not "free." Navigant implicitly assumes that the PTC does not have a fiscal impact and has no effect on job creation. The Joint Tax Commission estimates the fiscal impact of the PTC is $12.1 billion for a one-year extension. The money used to subsidize wind will eventually be withdrawn from the economy and cost jobs. While a comprehensive analysis of the job effects of the PTC's impact on the Treasury is outside the scope of this paper, they should not be ignored.

20 A National Renewable Energy Laboratory (NREL) report that utilized JEDI to model jobs created by wind capacity installation reported that, between 2009 and 2011, wind and solar projects created between 52,000 and 75,000 direct and indirect jobs during the construction phase and created between 5,100 and 5,500 direct and indirect jobs per year on an ongoing basis. However, NREL also admitted that, when existing jobs were exempted from the tally, only 770 direct jobs were attributable to large wind projects. Further, the NREL report admitted that its results were gross, rather than net estimates, and did not account for displacement of jobs or economic activity related to changes in existing power plants. *See*, Daniel Steinberg, Gian Porro, and Marshall Goldberg, *Preliminary Analysis of the Jobs and Economic Impacts of Renewable Energy Projects Supported by the §1603 Treasury Grant Program*, April 2012. Available at: http://www.nrel.gov/docs/fy12osti/52739.pdf.

21 *See*, Harker and Hirschboeck, *Green Job Realities – Quantifying the Economic Benefits of Generation Alternatives*, http://www.fortnightly.com/fortnightly/2010/05/green-job-realities

22 See footnote 4, page iii.

23 See David E. Dismukes, *Removing Big Wind's "Training Wheels": The Case For Ending the Federal Production Tax Credit* (American Energy Alliance, November, 1, 2012). Available at: http://www.americanenergyalliance.org/ wp-content/uploads/2012/10/Dismukes-Removing-Big-Winds-Training-Wheels.pdf

24 Adding operating jobs at 53 jobs per 1,000 MWs of wind would mean about 268 jobs, which would reduce the cost per job added by less than 11%.

CONCLUSIONS

Using energy policy to create jobs is never cost effective and is especially bad policy when used to pick "winners" by providing extraordinarily expensive subsidies like the PTC. Moreover, under any circumstances, the Report's wind capacity and job loss numbers have no credibility and should not be relied on to support any further extensions of the PTC. The Report's numerous calculation errors included:

- Using biased, self-serving industry forecasts and estimates, which created "lost" wind MWs estimates that are between 20% and 55% higher than impartial government wind capacity forecasts.
- Incorrectly using the JEDI model, which alone inflated job losses by at least 100% in the key states that were reviewed. Incorrectly applying the IMPLAN model using questionable multipliers, which inflated job losses by at least another 72%.
- Failing to consider other generating technologies that have greater job gains than wind per unit of capacity.

Given these numerous flaws the Report's job loss numbers are meaningless and provide no support for extending the PTC. Rather, extending the PTC will unnecessarily cost taxpayers billions of dollars and will not create any net American jobs. To the contrary, extending the PTC will reduce, not increase, American jobs.