

# FEDERAL ENERGY-RELATED TAX POLICY AND ITS EFFECTS ON MARKETS, PRICES, AND CONSUMERS

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## HEARING BEFORE THE SUBCOMMITTEE ON ENERGY OF THE COMMITTEE ON ENERGY AND COMMERCE HOUSE OF REPRESENTATIVES ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

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MARCH 29, 2017

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# **FEDERAL ENERGY-RELATED TAX POLICY AND ITS EFFECTS ON MARKETS, PRICES, AND CONSUMERS**

WEDNESDAY, MARCH 29, 2017

HOUSE OF REPRESENTATIVES,  
SUBCOMMITTEE ON ENERGY,  
COMMITTEE ON ENERGY AND COMMERCE,  
*Washington, DC.*

The subcommittee met, pursuant to call, at 10:21 a.m., in Room 2322 Rayburn House Office Building, Hon. Fred Upton (chairman of the subcommittee) presiding.

Members present: Representatives Upton, Olson, Barton, Shimkus, Murphy, Latta, Harper, McKinley, Kinzinger, Griffith, Johnson, Long, Bucshon, Flores, Mullin, Hudson, Walberg, Walden (ex officio), McNerney, Peters, Green, Castor, Sarbanes, Welch, Tonko, Loeb sack, Schrader, Kennedy, and Pallone (ex officio).

Staff present: Grace Appelbe, Legislative Clerk, Energy/Environment; Ray Baum, Staff Director; Mike Bloomquist, Deputy Staff Director; Karen Christian, General Counsel; Wyatt Ellertson, Research Associate, Energy/Environment; Blair Ellis, Press Secretary/Digital Coordinator; Tom Hassenboehler, Chief Counsel, Energy/Environment; A.T. Johnston, Senior Policy Advisor, Energy; Ben Lieberman, Senior Counsel, Energy; Brandon Mooney, Deputy Chief Energy Advisor; Mark Ratner, Policy Coordinator; Annelise Rickert, Counsel, Energy; Christopher Sarley, Policy Coordinator, Environment; Dan Schneider, Press Secretary; Peter Spencer, Professional Staff Member, Energy; Madeline Vey, Policy Coordinator, Digital Commerce and Consumer Protection; Evan Viau, Staff Assistant; Hamlin Wade, Special Advisor for External Affairs; Everett Winnick, Director of Information Technology; Andrew Zach, Senior Professional Staff Member, Environment; Jeff Carroll, Minority Staff Director; David Cwiertny, Minority Energy/Environment Fellow; Tiffany Guarascio, Minority Deputy Staff Director and Chief Health Advisor; Rick Kessler, Minority Senior Advisor and Staff Director, Energy and Environment; John Marshall, Minority Policy Coordinator; Jessica Martinez, Minority Outreach and Member Services Coordinator; Alexander Ratner, Minority Policy Analyst; and Tuley Wright, Minority Energy and Environment Policy Advisor.

**OPENING STATEMENT OF HON. FRED UPTON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MICHIGAN**

Mr. UPTON. Good morning, everybody. Sorry I'm late. Today's hearing gives us an opportunity to take a big-picture look at the effects of decades of Federal energy tax policy on energy markets, prices, and most importantly, consumers. So I'm hopeful that our discussion today will help us develop a deeper understanding of the costs and benefits of driving energy policy through the tax code. There is a great deal of interest in this topic and, with comprehensive tax reform on the agenda by the Ways and Means Committee, I look forward to working with them to deliver for the American people.

For decades, the Federal Government has used the tax code to support the energy sector and promote energy policy goals. Tax preferences provide the bulk of Federal support, and, to put that in perspective, in 2016, energy-related tax preferences cost an estimated \$18.4 billion, while relevant DOE spending programs cost nearly 6 billion.

Looking back on the historical trends, we see that tax treatments have been used for a variety of purposes. One of the primary motivations has been to bring down costs for alternative energy sources and other energy-related technologies that would have otherwise been uneconomic.

By some measures, tax subsidies have been pretty successful. For example, median installed prices for solar PV has fallen dramatically. Prices declined by 6 to 12 percent per year on average over the last 20 years, from about \$12 per watt to less than \$4 per watt, according to the DOE. Some critics might contend that solar costs would have come down anyway even without those tax measures, or that competing technologies were discouraged while solar was given an unfair advantage. Nonetheless, many see the role of the tax code as positive for the development of affordable solar energy.

Similar stories can be told for wind generation and energy-efficiency technologies. In 1980, the cost of wind energy was over \$500 per megawatt hour. Today, the levelized cost of wind energy is about \$50 per megawatt hour, according again to the EIA. In '05, the country reached its highest level of per capita electricity consumption. Today, electricity consumption continues to decline thanks to the adoption of energy-efficient technologies that were subsidized through the tax code.

Clearly, a strong argument can be made that specialized energy-tax treatments have played a major role in helping the U.S. achieve its energy goals. However, given the lasting market and price distorting impacts that these policies place on effective price formation and bidding in competitive markets, some are questioning whether yesterday's justification for energy-tax policies remain appropriate for today.

Today's markets are evolving to respond to new trends in energy production, electricity generation, technological innovation, and State policies, which are all having an impact, a positive one, on the proper functioning of the interstate wholesale electricity system.

So, as we look to modernize our energy policies, we are going to put consumers first. Consumers should be driving energy markets

from the bottom up rather than having the Federal Government driving them from the top. With tax reform on the horizon, Congress should be asking, How can we level the playing field to encourage competition, and will this policy grow our economy and keep energy policies affordable and reliable? Today's hearing is an important step in that process.

[The prepared statement of Mr. Upton follows:]

#### PREPARED STATEMENT OF HON. FRED UPTON

Good morning. Today's hearing gives us an opportunity to take a big picture look at the effects of decades of Federal energy-tax policy on energy markets, prices, and most importantly, consumers. I am hopeful that our discussion today will help us develop a deeper understanding of the costs and benefits of driving energy policy through the tax code. There is a great deal of interest in this topic and with comprehensive tax reform on the agenda, I look forward to working with our colleagues on the Ways and Means Committee to deliver for the American people.

For decades, the Federal Government has used the tax code to support the energy sector and promote energy-policy goals. Tax preferences provide the bulk of Federal support. To put this in perspective, in 2016, energy-related tax preferences cost an estimated \$18.4 billion, while relevant DOE spending programs cost \$5.9 billion.

Looking back on historical trends, we see that tax treatments have been used for a variety of purposes. One of the primary motivations has been to bring down costs for alternative energy sources and other energy-related technologies that would have otherwise been uneconomic.

By some measures, tax subsidies have been successful. For example, median installed prices for solar PV have fallen dramatically. Prices have declined by 6- 12 percent per year on average over the last 20 years from about \$12 per watt to less than \$4 per watt according to the DOE. Some critics might contend that solar costs would have come down anyway even without these tax measures, or that competing technologies were discouraged while solar was given an unfair advantage. Nonetheless, many see the role of the tax code as positive for the development of affordable solar energy.

Similar stories can be told for wind generation and energy-efficiency technologies. In 1980, the cost of wind energy was over \$500 per megawatt hour; today the leveled cost of wind energy is around \$50 per megawatt hour, according to EIA.

In 2005, the country reached its highest level of per capita electricity consumption; today, electricity consumption continues to decline thanks to the adoption of energy-efficient technologies that were subsidized through the tax code.

Clearly, a strong argument can be made that specialized energy-tax treatments have played a major role in helping the United States achieve its energy goals. However, , given the lasting market and price distorting impacts that these policies place on effective price formation and bidding in competitive markets, some are questioning whether yesterday's justifications for energy-tax policies remain appropriate for today. Today's markets are evolving to respond to new trends in energy production, electricity generation, technological innovation, and State policies, which are all having an impact on the proper functioning of the interstate wholesale electricity system.

As we look to modernize our energy policies, we're going to put consumers first. Consumers should be driving energy markets from the bottom up, rather than having the Federal Government driving it from the top down. With tax reform on the horizon, Congress should be asking "how can we level the playing field and encourage competition?" and "will this policy grow our economy and keep energy prices affordable and reliable?"

Today's hearing is an important step in this process.

With this goal in mind, I look forward to today's hearing and continuing the work with our colleagues on the Ways and Means Committee to modernize our tax code to reflect our changed energy landscape and 21st century realities.

Mr. UPTON. And I would yield to any of my colleagues on the right. The gentleman from the Texas, the vice chairman.

Mr. OLSON. I thank you, Mr. Chairman, and I will be very brief. This hearing is very important because all too often we are only looking at one side of the coin. Tax policy without a doubt moves

markets when it comes to energy. For example, my home State of Texas leads the Nation in wind power. Some of that is because of how the State has handled construction of power lines, but it is also absolutely true that the wind production tax credit is distorting our markets.

At the same time, there are credits that give a leg up on some sources and leave others behind. In our current tax system, DC bureaucrats pick winners and losers and they have a dubious record. They always pick the losers. My fellow Texan, Kevin Brady, is on the driver's seat for tax reform. I am glad we are having this hearing this morning and can be part of that conversation. I yield back.

Mr. UPTON. I appreciate the gentleman's testimony. Now I will look to my friends on my left. I recognize Mr. McNerney for 5 minutes for an opening statement.

**OPENING STATEMENT OF HON. JERRY MCNERNEY, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA**

Mr. MCNERNEY. Well, I thank you, Mr. Chairman, and this is an area I care a lot about. You know, climate change has been happening, it is affecting our water, our air, our public health, and our environment. And despite all this, yesterday, our President signed an executive order to retract the Clean Power Plan, to roll back carbon standards for new power plants, to rescind methane standards, and it is unfortunate that the administration is trying to undo the progress that we have made while ignoring where our energy sector is actually heading. We should be a world leader in clean energy.

Our hearing today is about the larger implication of our Nation's energy-tax policy. We use the tax code for a lot of stuff, for incentivizing things like water use, energy deployment and directing business expenditures, and we use tax policies to encourage innovation. The Federal Government plays a critical role in supporting energy development and production and this leads to increased efficiency, jobs, and reduced emissions.

I worked in the renewable energy sector for 2 decades before coming to Congress back when we actually had to climb windmills to work on them up on the top of the towers. So I have seen firsthand how the industry has grown from the late 1980s to where it is today, and I saw more than once what happens when Federal subsidies change. We saw innovation and jobs and industry going overseas during periods of low Federal support.

However, we have learned from that mistake and the Federal Government has taken a steadier hand. Let's look at some of the progress with wind. The wind capacity has doubled since 2010. It represents nearly one-third of all new electricity generation capacities since 2007; and in 2016, 15,000 new jobs were directly created in wind energy, and 102,000 indirect full-time jobs were created.

Now, with solar there is a record 14,800 megawatts of solar capacity installed in 2016, over 42,000 megawatts installed in the U.S. That is more than eight million homes and this is key, it created over 260,000 jobs just in 2016. So we are moving in the right direction. In hydropower about 101 gigawatts capacity, that is a lot of big watts. A lot of capacity was added with potential to grow to

150 more gigawatts by 2050. This would mean \$209 billion in savings from avoided global damages from greenhouse gas emissions.

The U.S. tax code supports the energy sector by providing a number of targeted tax incentives related to production of fossil fuels, nuclear power, renewable energy, and energy-efficiency technology. Oil and gas firms benefit from a number of direct and indirect subsidies that increase their profitability and these are permanent subsidies, whereas the renewable sector the subsidies are always grandfathered and always sunset.

Now, it is not about and it shouldn't be about picking winners and losers. We can have a reliable generation developed in this country that is zero or low emission. I think it is unfair to overly simplistically claim that the tax incentives have somehow ruined the wholesale/retail markets across this country. For example, in California is one of the three least carbon-intensive economies in the world, and in 2014, California averaged monthly residential bills were 20 percent lower than the U.S. as an average. The argument ignores such factors as changes in our centralized versus decentralized generation, policies intended to protect our air and water resources, natural gas prices and transmission congestion.

In order for the U.S. to remain globally competitive we need to recognize a couple of things. We have to decarbonize the electric sector and we need to modernize our electric grid. The Nation's electric grid is undergoing rapid changes right now that we have seen new technologies help shift the market structure across the United States. This includes demand-response and distributed energy sources. The boom in solar and wind, the potential for storage, has allowed customers and consumers to become more engaged in the electricity market including selling energy back to the grid.

These dynamics along with the more cost competitive nature of renewable energy has been driving the wheel where we need to go. It will be important that we have a grid that is able to incorporate this growing clean energy to the variable energy needs and can reliably produce energy regardless of the generation sources. I am about to run out of time so I am going to wrap up here. The market is moving toward clean, renewable energy. Let's not change that. With that, I yield back.

Mr. UPTON. I would have given my friend on the left an extra 10 seconds, so thank you. I recognize the chairman of the full committee, the gentleman from Oregon, Mr. Walden. Go Ducks.

Mr. WALDEN. Thank you very much. Go Ducks, yes. Sorry about Michigan.

Mr. UPTON. Time has expired.

[Laughter.]

Mr. WALDEN. That is what happened, kind of ran out.

**OPENING STATEMENT OF HON. GREG WALDEN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF OREGON**

Over the last decade, the United States has undergone an energy revolution. I think we all know that. Old assumptions have been proven wrong and the future of energy production is brighter than it has ever been, and the shale revolution made the peak oil theory simply obsolete, while technological advances combined with greater market competition have driven power sector emissions down

below 2005 levels. And new information and communication technologies are providing consumers new insights into their energy consumption habits that were once taken for granted.

While some of these developments have been assisted by Federal policy, the bulk of the changes are the result of market forces over the last decade. So much of our Federal energy policy is designed to address an antiquated marketplace that looks entirely different than the one we see emerging today. This is especially true regarding tax policy. A host of energy-related provisions have intermittently been added to the tax code over decades. This includes everything from tax credits for renewable electricity production to incentives for installing energy-saving devices in our homes. Now, there are also provisions that create favorable depreciation schedules for certain energy investments. The list goes on and on.

We have allowed these tax measures to accumulate, frankly, without sufficient oversight, and it is time to give them a long-overdue checkup. For example, it is not hard to find instances where tax credits encourage a particular activity but tough regulations and lengthy permitting delays are at the same time discouraging it. We are also seeing more State-level interventions through tax and nontax policy in the markets, which add another layer of complexity to this issue.

So I think it is important for all of us, the committee of jurisdiction on energy matters, to understand all of these energy-related policies and view them in an integrated fashion, which is why we are having this hearing today. The stakes could hardly be higher. Getting energy-tax policy right can preserve millions of jobs in the energy and manufacturing sectors while potentially adding many more emerging sectors in the years ahead. Our efforts can also bolster our economic strength as America continues to emerge as the 21st century's newest energy superpower and expand its export market opportunities.

However, what ultimately matters most are these policy impacts on consumers. We need to do what is best for households struggling to pay the electric or gas bill. Open and competitive markets are the surest way to keep prices down for families while taking full advantage of the technological improvements that give consumers more control over the way we use energy.

This Congress we will examine how energy and electricity markets, and the policies affecting those markets, are impacting consumers. Congress will also need to consider ways to modernize and better integrate tax-related energy policy. But before we reach that point we need to have a broader understanding of where our energy policies stand right now, and that is why we are here today. So we appreciate our witnesses' testimony and your guidance and counsel you will give us today and in the future.

Mr. Chairman, I thank you for your leadership on this issue as well. I can tell you in Oregon we have a robust energy policy. In my district alone we have thousands and thousands of megawatts of wind energy, we have great potential for geothermal energy, we have solar energy, and of course massive hydroelectric energy throughout the Northwest.

So we have been on the forefront of renewable energy for a long time. It has been a good thing, but I think it is always good to look

and evaluate it, how all these incentives and subsidies and all affect the market and are they really needed. In some areas, some they are, some maybe not. Some maybe have come to maturity and don't need them at all. Others may continue to need them.

I think it is important for us to take a look at the whole panoply of support systems, markets, and look at the grid as well, you know we are doing that in your committee, as we look at the whole issue going forward. So thank you, Mr. Chairman, for doing this hearing. I look forward to hearing from our witnesses. I would admit up front I have another subcommittee I am bouncing back and forth between, but I have all your testimony. Thank you, and I yield back.

[The prepared statement of Mr. Walden follows:]

#### PREPARED STATEMENT OF HON. GREG WALDEN

Over the last decade, the United States has undergone an energy revolution. Old assumptions have been proven wrong and the future of energy production is brighter than it has ever been. The shale revolution made the peak oil theory obsolete, while technological advances, combined with greater market competition have driven power sector emissions down below 2005 levels. And new information and communication technologies are providing consumers new insights into their energy-consumption habits that were once taken for granted. While some of these developments have been assisted by Federal policy, the bulk of the changes are the result of market forces over the last decade.

So much of our Federal energy policy is designed to address an antiquated marketplace that looks entirely different than the one we see emerging today. This is especially true regarding tax policy. A host of energy-related provisions have intermittently been added to the tax code over decades. This includes everything from tax credits for renewable electricity production to incentives for installing energy-saving devices in our homes. There are also provisions that create favorable depreciation schedules for certain energy investments. The list goes on.

We have allowed these tax measures to accumulate without sufficient oversight, and it is time to give them a long-overdue check-up. For example, it is not hard to find instances where tax credits encourage a particular activity but tough regulations and lengthy permitting delays are at the same time discouraging it. We are also seeing more State-level interventions through tax and nontax policy in the markets, which add another layer of complexity to this issue.

It is important for us, the committee of jurisdiction on energy matters, to understand all of these energy-related policies and view them in an integrated fashion.

The stakes could hardly be any higher. Getting energy-tax policy right can preserve millions of jobs in the energy and manufacturing sectors while potentially adding many more in emerging sectors in the years ahead. Our efforts can also bolster our economic strength as America continues to emerge as the 21st century's newest energy superpower and expand its export market opportunities.

However, what ultimately matters most are these policy impacts on consumers. We need to do what is best for households struggling to pay the electric or gas bill. Open and competitive markets are the surest way to keep prices down for families while taking full advantage of the technological improvements that give consumers more control over the way they use energy.

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I welcome today's witnesses and look forward to hearing their thoughts on today's energy policies.

Mr. UPTON. The gentleman yields back. The Chair recognizes the ranking member of the full committee, Mr. Pallone from New Jersey, for 5 minutes.

**OPENING STATEMENT OF HON. FRANK PALLONE, JR., A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW JERSEY**

Mr. PALLONE. Thank you, Mr. Chairman. Thanks for holding this hearing on how tax policy affects our Nation's energy policy. The conversation of late has focused on the various tax credits that benefit solar, wind, and other renewables, yet every form of energy produced receives some form of favorable tax treatment. Many also receive favorable regulatory treatment as well.

And this is not new. It can be traced back to the tariffs giving domestic coal an advantage right after we became a nation. Coal and wood fueled the early growth of our country and the railroads that eventually connected it, while the Government put forward policies that helped underwrite dominance of all three. And looking back on the 20th century, Federal energy-tax subsidies almost entirely benefited oil and gas interests. It wasn't until the early 1900s, I should say the early 1990s that the Federal Government began to provide meaningful tax credits for energy produced from renewable resources.

So, when someone pulls out a statistic from a given year in recent memory citing the preponderance of tax credits for renewable energy, it is worth remembering that coal, oil, and gas have benefited from centuries of beneficial tax treatment, and many of those fossil incentives are permanent, unlike the temporary nature of tax credits for renewables. Now, let me be clear: I am not taking issue with tax incentives or saying it is a bad thing in any way to have supported all of these technologies at certain times throughout our history. But it is important to put today's hearing in context.

As I said, there have been and likely will continue to be subsidies for all types of energy production. But our task as legislators now is to determine where Federal support should be focused. The choices we make in providing tax benefits to one type of generation versus another have real world impacts on the energy sector. And these are important choices because we must keep energy affordable, but we must also think about the impacts certain sources of energy have on human health and the environment.

The Federal Government should be incentivizing technologies that are cleaner, safer, and more protective of the health of all Americans. The renewable energy sources in particular provide societal benefits that cannot be effectively valued by the markets. Another important factor we must consider are new technologies with clear benefits to the electricity grid such as battery storage and energy efficiency.

Tax subsidies are among the policy drivers least understood by the general public. This is largely because they also are the least transparent. Many are only known because they expire and have to be reconsidered every few years. However, there are many more that are not known to the public because they are permanent in nature. For example, oil and gas firms can organize as master limited partnerships, a corporate form that allows the companies to pass-through profits without paying corporate taxes. And this benefit continues in perpetuity with no reauthorization by Congress needed.

There are also many nontaxed regulatory subsidies that I hope will not be overlooked as we consider subsidies and the impact on the energy market. For instance, Section 404 of the Clean Air Act literally contains the names of hundreds of coal-fired electric generating units that were each given the right to emit thousands of tons of sulphur dioxide pollution extending their operating lives and keeping them competitive with cleaner forms of energy.

Another example, the Superfund statute excludes oil and gas from the definition of hazardous substance, providing massive liability protection to one specific energy sector that is often a major source of contamination in communities around the country. This provides an economic boost that would otherwise be on the hook for expensive cleanups. Similarly, oil and gas exploration and production waste are excluded from RCRA regulations. All of this special treatment directly affects the costs associated with producing and distributing oil, gas, and electricity at the expense of taxpayers and the environment.

So Mr. Chairman, if we are to move down this path of examining tax subsidies we must also consider all subsidies, direct, indirect, and regulatory. And I believe the tax policies should seek to limit the cost of pollution to society including the costs that regulatory subsidies often effectively shift from companies onto the taxpayer and the environment itself. Unfortunately, if fuels and energy truly reflect the long-term cost to society and the environment as well as individuals, people will make rational choices that will benefit all of us. And I yield back.

[The prepared statement of Mr. Pallone follows:]

PREPARED STATEMENT OF HON. FRANK PALLONE, JR.

Thank you, Mr. Chairman, for holding this hearing today on how tax policy affects our Nation's energy policy.

The conversation of late has focused on the various tax credits that benefit solar, wind and other renewables. Yet every form of energy produced receives some type of favorable tax treatment. Many also receive favorable regulatory treatment as well. This is not new—it can be traced back to the tariffs giving domestic coal an advantage right after we became a nation. Coal and wood fueled the early growth of our country and the railroads that eventually connected it, while the Government put forward policies that helped underwrite dominance of all three. And, looking back on the 20th century, Federal energy-tax subsidies almost entirely benefitted oil and gas interests.

It wasn't until the early 1990s that the Federal Government began to provide meaningful tax credits for energy produced from renewable sources. So, when someone pulls out a statistic from a given year in recent memory citing the preponderance of tax credits for renewable energy, it's worth remembering that coal, oil and gas have benefitted from centuries of beneficial tax treatment. And, many of those fossil incentives are permanent, unlike the temporary nature of tax credits for renewable energy.

Now, let me be clear, I am not taking issue with tax incentives or saying it is a bad thing in any way to have supported all these technologies at certain times throughout our history, but it is important to put today's hearing in context. As I said, there have been, and likely will continue to be, subsidies for all types of energy production. Our task as legislators now is to determine where Federal support should be focused.

The choices we make in providing tax benefits to one type of generation versus another have real world impacts on the energy sector. These are important choices because we must keep energy affordable, but we must also think about the impacts certain sources of energy have on human health and the environment. The Federal Government should be incentivizing technologies that are cleaner, safer, and more protective of the health of all Americans. Renewable energy sources, in particular, provide societal benefits that cannot be effectively valued by the markets. Another

important factor we must consider are new technologies with clear benefits to the electricity grid, such as battery storage and energy efficiency.

Tax subsidies are among the policy drivers least understood by the general public. This is largely because they are also the least transparent. Many are only known because they expire and have to be reconsidered every few years. However, there are many more that are not known to the public because they are permanent in nature. For example, oil and gas firms can organize as Master Limited Partnerships, a corporate form that allows the companies to pass through profits without paying corporate taxes. And this benefit continues in perpetuity with no reauthorization by Congress needed.

There are also many nontax, regulatory subsidies that I hope will not be overlooked as we consider subsidies and their impact on the energy market. For instance, Section 404 of the Clean Air Act literally contains the names of hundreds of coal-fired electric generating units that were each given the right to emit thousands of tons of sulfur dioxide pollution, extending their operating lives and keeping them competitive with cleaner forms of energy.

Another example: the Superfund statute excludes oil and gas from the definition of a hazardous substance, providing massive liability protection to one specific energy sector that is often a major source of contamination in communities across the country. This provides an economic boost to companies that would otherwise be on the hook for expensive cleanups. Similarly, oil and gas exploration and production wastes are excluded from RCRA regulations. All of this special treatment directly affects the costs associated with producing and distributing oil, gas, and electricity at the expense of taxpayers and the environment.

Mr. Chairman, if we are to move down this path of examining tax subsidies, we must consider all subsidies: direct, indirect, and regulatory. I believe that tax policies should seek to limit the cost of pollution to society, including the costs that regulatory subsidies often effectively shift from companies onto the taxpayer and the environment itself. Ultimately, if fuels and energy truly reflect their long-term costs to society and the environment as well as individuals, people will make rational choices that will benefit all of us.

Mr. UPTON. The gentleman yields back.

We are delighted to have the witnesses that we have today, and I am told that our computer is back online so we can have the little presentation. We are joined by Terry Dinann—

Dr. DINAN. Dinan.

Mr. UPTON. Dinan. I am sorry—Senior Advisor from CBO; Ben Zycher, Resident Scholar and John G. Searle Chair from AEI; Robert Murphy, Senior Economist, Institute for Energy Research; Devin Hartman, Electricity Policy Manager for the R Street Institute; Joseph Aldy, Associate Professor from Harvard, School of Government; and Steve Clemmer, Director of Energy Research and Analysis from the Union of Concerned Scientists.

Thank you all for being here. Dr. Dinan—

Dr. DINAN. Thank you.

Mr. UPTON [continuing]. Thank you. You are recognized for 5 minutes.

**STATEMENTS OF TERRY DINAN, PH.D., SENIOR ADVISOR, MICROECONOMIC STUDIES DIVISION, CONGRESSIONAL BUDGET OFFICE; ROBERT P. MURPHY, PH. D., SENIOR ECONOMIST, INSTITUTE FOR ENERGY RESEARCH; DEVIN C. HARTMAN, ELECTRICITY POLICY MANAGER AND SENIOR FELLOW, R STREET INSTITUTE; STEVE CLEMMER, DIRECTOR OF ENERGY RESEARCH AND ANALYSIS, CLIMATE & ENERGY PROGRAM, UNION OF CONCERNED SCIENTISTS; JOSEPH E. ALDY, ASSOCIATE PROFESSOR OF PUBLIC POLICY, HARVARD KENNEDY SCHOOL; AND BENJAMIN ZYCHER, PH.D., JOHN G. SEARLE CHAIR AND RESIDENT SCHOLAR, AMERICAN ENTERPRISE INSTITUTE**

**STATEMENT OF TERRY DINAN**

Dr. DINAN. Thank you. Chairman Upton, Congressman McNerney, and members of the subcommittee, thank you for the invitation to testify on the support that the Federal Government provides for the development, production, and use of energy and technologies and fuels. In fiscal year 2016, tax preferences provided the bulk of that support. Based largely on estimates from the staff at the Joint Committee on Taxation, energy-tax preferences resulted in \$18.4 billion in foregone revenues. In contrast, spending programs administered by the Department of Energy totaled \$5.9 billion.

First, I would like to discuss tax preferences. As shown on the display, for most years until 2005, the largest share of that support went to domestic producers of oil and natural gas. Beginning in 2006, the cost of energy-related tax preferences grew substantially. Moreover, an increasing share of those costs was aimed at encouraging energy efficiency and the use of energy produced from renewable sources.

Now I will turn to the breakdown of tax preferences in fiscal year 2016. As shown in this figure, provisions aimed at energy efficiency and renewable energy accounted for about 75 percent of all energy-related tax preferences and provisions aimed at fossil fuels made up most of the remaining amount. Under current law, the mix of energy-tax preferences will look quite different in the future. That is because about \$5 billion, or a little more than 35 percent of the support for energy efficiency and renewable energy came from provisions that expired at the end of calendar year 2016.

In contrast, most of the support for fossil fuels and nuclear power came from provisions that are permanent. Although temporary tax preferences have often been extended, their lack of permanence creates uncertainty and reduces the extent to which they are likely to motivate investment. Next, I would like to turn to the Department of Energy. Oops, it doesn't seem to be flipping. OK.

DOE supports energy technologies by making investments in them and by subsidizing and guaranteeing loans. DOE's funding has also changed over time, but with the exception of 2009 has generally been less since 2010 than it was in the early 1990s. Looking at fiscal year 2016, we find that 35 percent of DOE's support for energy technologies is directed towards energy efficiency and renewable energy, 31 percent supports basic science, 15 percent is directed at nuclear energy, and 11 percent at fossil fuels.

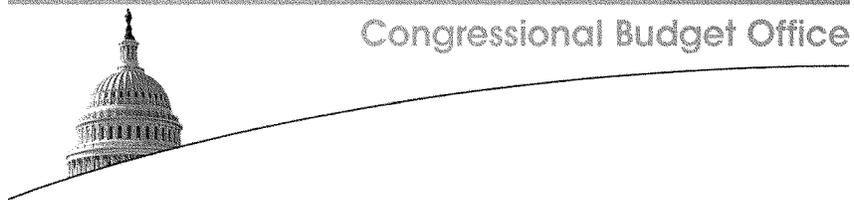
Boosting domestic production of oil and gas, reducing greenhouse gas emissions, and encouraging research that would benefit society have historically been central goals motivating the support of energy. Determining the cost effectiveness of Federal support in achieving those goals is difficult. However, in 2015, CBO estimated that over the previous decade tax preferences increased U.S. production of crude oil by less than one percent and did so at a cost of roughly \$90 to \$200 per additional barrel of oil produced. In addition, a 2013 study by the National Research Council indicated that production investment tax credits for renewable electricity generation reduced carbon dioxide emissions at an average cost of \$250 per ton, a value that is several times higher than a commonly used estimate of the benefit of such reductions.

Evaluating the effects of R&D is also challenging. However, Government funding is most likely to be cost effective when it supports research on the basic science of energy or research aimed at very early stages of technology development. Such research is typically underinvested in by private entities because it creates benefits for society as a whole but may not be profitable for firms to undertake on their own.

Finally, I would like to note that multiple factors affect the mix of fuels and energy technologies in the U.S. For example, the share of electricity generated by renewables is influenced by tax preferences as well as by State-level mandates to increase the production of electricity from wind, solar, or biomass. Likewise, the mix of fuels used in the transportation sector has been affected not only by the provision of tax preferences for renewable fuels, but also by the Federal Renewable Fuel Standard which mandates the use of particular quantities of renewable fuels. Estimating the extent to which tax preferences influence producer and consumer choices requires careful analysis that controls for those other influences.

Thank you for the opportunity to testify and I am happy to answer any questions you might have.

[The prepared statement of Dr. Dinan follows:]



**Testimony**

**Federal Support for Developing, Producing, and  
Using Fuels and Energy Technologies**

**Terry Dinan  
Senior Adviser  
Microeconomic Studies Division**

**Before the Subcommittee on Energy  
Committee on Energy and Commerce  
U.S. House of Representatives**

**March 29, 2017**

*This testimony will be delivered on Wednesday,  
March 29, 2017, at 10:15 a.m. (EDT).*

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## Notes

Unless otherwise noted, years referred to in this testimony are federal fiscal years, which run from October 1 through September 30 and are designated by the calendar year in which they end.

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

All dollar amounts are expressed in fiscal year 2016 dollars unless otherwise noted. Nominal (current-year) amounts were adjusted to remove the effects of inflation by using the gross domestic product deflator.

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Chairman Upton, Ranking Member Rush, and Members of the Subcommittee, thank you for the invitation to testify on federal financial support for the development, production, and use of fuels and energy technologies. My testimony updates a Congressional Budget Office report from 2015 on the same topic.<sup>1</sup>

### Summary

The federal government provides financial support for the development, production, and use of fuels and energy technologies both through tax preferences and through spending programs administered by the Department of Energy (DOE). Policymakers have provided that support with several goals in mind, including increasing domestic energy production, reducing greenhouse gas emissions, and encouraging research that might benefit society but that would not be profitable for private firms to undertake without government funding.

In fiscal year 2016, tax preferences provided the bulk of federal support for energy development, production, and use. Whereas tax preferences are estimated to have resulted in \$18.4 billion in forgone revenues, lawmakers appropriated funds equal to about one-third of that amount—\$5.9 billion—for DOE to fund the relevant spending programs.

### How Does the Federal Government Support the Development, Production, and Use of Fuels and Energy Technologies?

One way in which federal support is provided is through tax preferences—special provisions of tax law that reduce tax liabilities for certain activities, entities, or groups of people—for both producers and users of certain fuels and energy technologies. Preferences aimed at producers increase the profitability of investing in a particular technology (tax credits for generators that produce electricity from wind, for example) or lower the cost of producing certain fuels (depletion allowances for producing oil and natural gas, for example). Preferences aimed at users lower their after-tax cost of purchasing certain products; for instance, tax credits subsidize homeowners' investments in energy-efficient windows.

1. Congressional Budget Office, *Federal Support for the Development, Production, and Use of Fuels and Energy Technologies* (November 2015), [www.cbo.gov/publication/50980](http://www.cbo.gov/publication/50980).

Federal assistance is also provided through DOE in the form of funding for basic research and technology development. In particular, DOE funds research that furthers the understanding of the basic science underlying energy or that supports the development of new energy technologies. It provides funding for universities and government laboratories, demonstration projects, and loans or loan guarantees for energy technologies. Other federal programs (both within and outside DOE) affect energy markets and the supply of energy resources; for example, the government's leasing of federal lands for oil production boosts the supply of oil. This testimony, however, examines only federal spending that encourages either basic research or the development of new energy technologies.

### How Has Federal Support Changed Over Time?

From the introduction of tax preferences for oil producers in the Revenue Act of 1916 until 2005, the largest share of energy-related tax preferences went to domestic producers of oil and natural gas. Beginning in 2005, the composition of those preferences changed: An increasing share of them was aimed at encouraging the use of energy-efficient technologies and of energy generated from wind, the sun, and other renewable sources. Along with those changes came a fivefold increase in the inflation-adjusted cost of tax preferences, from \$4.9 billion in 2004 to a peak of \$25.7 billion in 2012. Since then, the value of tax preferences has fallen by almost 30 percent, to an estimated total of \$18.4 billion in 2016.

DOE's funding has also changed over time, but with the exception of the substantial amounts provided in 2009 by the American Recovery and Reinvestment Act (ARRA) and a onetime appropriation for the Advanced Technology Vehicles Manufacturing (ATVM) loan program, it has generally been less, adjusted for inflation, since 1998 than it was between 1985 (the first year included in this analysis) and 1998. Whereas such funding (measured in 2016 dollars) averaged \$7.6 billion each year in the early 1990s, it has averaged \$5.0 billion a year since 2010.

DOE's funding includes appropriations to cover the subsidy costs of loans and loan guarantees for the development of new energy technologies. In recent years, DOE has extended credit through three major programs, although the authority to make new loan guarantees for one of those programs expired on September 30, 2011. Of the \$9.5 billion (in nominal dollars) of funding for credit subsidies that lawmakers have provided since 2009, DOE has obligated \$4.7 billion thus far. The

department's funding for 2016 included only small amounts for the administrative expenses of its credit programs; no new funds were provided for loans or loan guarantees.

#### **How Effective Has That Support Been at Increasing Domestic Production, Reducing Greenhouse Gas Emissions, and Spurring Research and Development?**

Increasing the domestic production of oil and gas has long been a goal of federal policy, and following the disruptions in the global supply of oil in the 1970s, the emphasis on boosting domestic oil production only intensified. Although U.S. production of crude oil has increased over the past 10 years, by CBO's estimates only a small share of that increase resulted from tax preferences. In 2015, CBO estimated that the preferences cost between \$90 and \$200 per additional barrel of oil produced, a cost that was in addition to the market price of oil, which averaged \$80 per barrel over the previous decade.

In the mid-2000s, the share of energy subsidies aimed at reducing greenhouse gas emissions, particularly carbon dioxide (CO<sub>2</sub>) emissions, began to grow. The most efficient method for reducing emissions would be to set a price on fossil fuels that reflects the damage caused by the production and use of the fuel. Tax preferences and other subsidies for the development and use of favored technologies can also reduce emissions, but they are less cost-effective. Although some studies have found that certain technologies, including those for generating electricity from wind, have been responsive to subsidies, a review by the National Academy of Sciences (NAS) concluded that the tax credit for the generation of electricity from renewable sources reduced CO<sub>2</sub> emissions at an average cost of \$250 per ton. By comparison, federal agencies recently estimated that the value of the benefits of reducing CO<sub>2</sub> emissions is between \$40 and \$65 per ton.

Promoting research and development (R&D) has long been another motivation behind federal energy subsidies. Government funding is most likely to be cost-effective when it supports research that would benefit society but that would not be profitable for firms to undertake on their own, such as research on the basic science of energy or research aimed at the very early stages of technology development. Estimating the returns on investments in basic science research is difficult; however, such research can lead to knowledge that can be used in unforeseen ways, sometimes long after the research is completed, and

some evidence suggests that, taken as a whole, the returns from basic science research have been substantial. Estimating returns on investments in applied research is somewhat easier, and evidence suggests that DOE's funding of such research has had mixed results. Funding work in the early stages of developing new energy technologies has generally been more cost-effective than supporting large demonstration projects for new technologies. Despite those mixed results, federal funding of energy research has led to a significant amount of technology transfer to private firms.

#### **Tax Preferences**

The federal government supports the production and use of fossil fuels, nuclear power, and renewable energy and encourages energy efficiency through provisions of law that reduce the tax liability of producers and consumers. Those tax preferences include special deductions, lower tax rates, tax credits, and grants in lieu of tax credits. Primarily on the basis of projections prepared by the staff of the Joint Committee on Taxation, CBO estimates that energy-related tax preferences totaled \$18.4 billion in 2016.

In addition to benefiting from tax preferences that support the production of fuels or improvements in energy efficiency, energy producers benefit from tax preferences that are available to all businesses, such as the one that allows companies to defer tax payments on overseas earnings. Because those preferences support industry generally—not just energy-related activities—they are not included in the above estimate. Energy-related tax preferences account for only a small percentage of the cost of all federal tax preferences, which total hundreds of billions of dollars each year.<sup>2</sup>

#### **Historical Trends**

The value of tax preferences related to energy and the composition of that financial support have changed over time.<sup>3</sup> Those changes stem from a combination of factors, including the addition and expiration of specific energy-related tax preferences; fluctuations in the prices of oil and natural gas, which affect investment in those

2. For a recent estimate of such costs, see Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2016–2020*, JCX-3-17 (January 30, 2017), <http://go.usa.gov/xXBA6>.

3. For more information, see Joint Committee on Taxation, *Present Law and Analysis of Energy-Related Tax Expenditures*, JCX-46-16 (June 9, 2016), <http://go.usa.gov/xXBAF>.

industries; and increases or decreases in overall tax rates, which make existing tax preferences more or less valuable.

Tax preferences to encourage the production of fossil fuels made up the bulk of all energy-related tax incentives from the passage of the Revenue Act of 1916 through the mid-2000s; tax preferences for oil and natural gas producers accounted for more than two-thirds of the total cost of all preferences in most years. Most of those tax preferences are permanently in place, but since the mid-2000s, new legislation has expanded the scope of federal energy policy, and the share of total financial support provided through energy-related tax incentives that goes toward the production of fossil fuels has decreased.

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 promoting the use of alternative-fuel motor vehicles, such as fuel-cell and hybrid vehicles. As a result, it substantially increased the number of energy-related tax preferences and their total cost. By 2008, fossil fuels accounted for only about one-third of the total cost of energy-related tax incentives.

Subsequent legislation has further increased the amount of federal resources devoted to energy-related tax preferences and decreased the share of those preferences that go to producers of fossil fuels. The Emergency Economic Stabilization Act of 2008 extended and expanded tax preferences related to renewable energy and energy efficiency. Shortly thereafter, ARRA temporarily expanded tax preferences for promoting energy efficiency, renewable energy, and alternative vehicles. It also created the Section 1603 grant program, which allowed producers of renewable energy to collect onetime cash payments in lieu of future tax credits.<sup>4</sup>

The estimated cost of energy-related tax preferences fell dramatically between 1985 and 1988, in part because tax rates and fuel prices declined in those years (see Figure 1).

4. Before the availability of Section 1603 grants, 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. With such grants, recipients no longer needed to enter into specialized financing arrangements (which ultimately reduce the value of the incentive that goes to the producers of renewable energy) to monetize tax credits.

From 1988 to 2004, the cost of such tax preferences grew gradually, averaging about \$4 billion per year in 2016 dollars. After the Energy Policy Act of 2005 was enacted, tax expenditures rose sharply. Support was especially great from 2009 to 2013—peaking at \$25.7 billion in 2012—partly as a result of stimulus provisions intended to reduce the effects of the recession that the United States faced from 2007 to 2009.<sup>5</sup> Tax support has fallen over the past few years: In 2016, the preferences totaled roughly 70 percent of those that were provided in 2012.

#### Tax Preferences in 2016

Roughly three-fourths of the projected cost of tax preferences for energy in 2016 was for renewable energy and energy efficiency (see Figure 2). An estimated \$10.9 billion, or 59 percent of the energy-related tax preferences, was directed toward renewable energy; \$2.7 billion, or 15 percent, went to energy efficiency or electricity transmission. Fossil fuels accounted for most of the remaining cost of energy-related tax preferences—an estimated \$4.6 billion, or 25 percent.

The tax preferences that explicitly target energy use and production are provided through three mechanisms: preferences in the income tax system, such as special deductions, lower tax rates, and tax credits; preferences in excise taxes, such as excise tax credits; and Section 1603 grants in lieu of tax credits (see Table 1).<sup>6</sup> In 2016, total energy-related support included the following amounts:

- \$14.1 billion for energy-related preferences in the income tax code. Of that amount, preferences for renewable energy (\$6.6 billion) accounted for the largest share, and those for fossil fuels (\$4.6 billion), the second largest. The two most costly preferences were the credits for electricity production from renewable

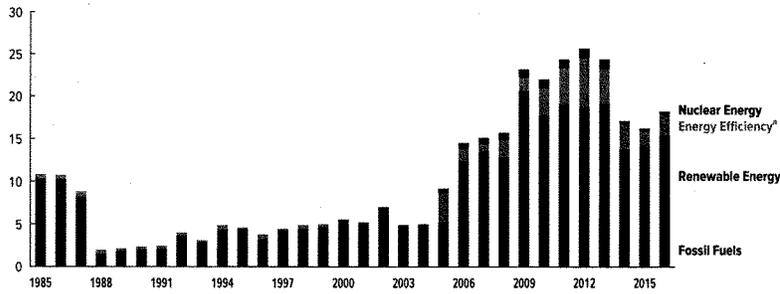
5. Those provisions of ARRA caused revenue losses to increase significantly in 2009 and 2010. See Margot L. Crandall-Hollick and Molly F. Sherlock, *Residential Energy Tax Credits: Overview and Analysis*, Report for Congress R42089 (Congressional Research Service, March 18, 2014).

6. CBO includes the Section 1603 grants among tax preferences because the federal support for projects provided under that program originates through the tax system, and eligibility for such support is determined by the eligibility of a project to receive tax support.

Figure 1.

**Costs of Energy-Related Tax Preferences, by Type of Fuel or Technology, 1985 to 2016**

Billions of 2016 Dollars



Source: Congressional Budget Office, using 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, and updated data from the Congressional Research Service; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2016–2020*, JCX-3-17 (January 30, 2017), pp. 29–30, <http://go.usa.gov/xxBA6>; staff of the Joint Committee on Taxation, "Estimated Budget Effects of Division Q of Amendment #2 to the Senate Amendment to H.R. 2029 (Rules Committee Print 114-40), The 'Protecting Americans From Tax Hikes Act of 2015,'" JCY-143-15 (December 16, 2015), <http://go.usa.gov/xxKNZ>; Department of the Treasury, *Combined Statement of Receipts, Outlays, and Balances* (December 2016), <http://go.usa.gov/xxKNS>; and Office of Management and Budget, *Budget of the U.S. Government, Fiscal Year 2017: Appendix* (February 2016), p. 1025, <http://go.usa.gov/xxKNR>.

The estimates of the costs of individual tax preferences do not account for any potential interactions between preferences or include the costs of those tax provisions estimated to result in less than \$50 million in forgone revenues. Nor do they reflect the amount of revenues that would be raised if those preferences were eliminated and taxpayers adjusted their activities in response to those changes.

a. Includes the costs of tax preferences related to the transmission of electricity, which are typically small.

sources (\$3.4 billion) and the credits for investments in solar and geothermal equipment, fuel cells, and microturbines (\$2.6 billion).

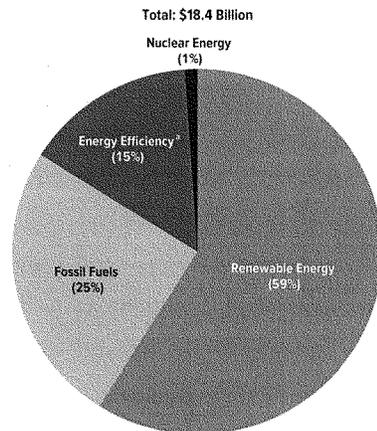
- \$4.2 billion for excise tax credits and other incentives for biodiesel and alternative fuels.
- \$0.1 billion for grants under the Section 1603 program. Section 1603 grants allow producers of renewable energy to take a cash grant in lieu of a tax credit; the grant is provided once the qualifying facility is put into service. Although those 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 qualified for the option. Thus, some grants were disbursed in 2016.

Whereas most tax preferences related to fossil fuels are permanent features of the tax code, most of the preferences for renewable energy sources and energy

efficiency are temporary and will continue to be available only if they are extended. (About \$5 billion of the revenue forgone in 2016 stems from tax preferences that expired in December 2016.) Although temporary preferences have often been extended, their lack of permanence creates uncertainty about the extent to which they will lower future production costs (or, if the credits are provided to consumers, increase future demand). The temporary nature of preferences for renewable energy sources and energy efficiency creates less incentive to invest in those technologies than there would be if those preferences were permanent; however, the magnitude of the reduction in investment due to that uncertainty is unknown.<sup>7</sup>

7. Testimony of Gilbert E. Metcalf, Professor of Economics, Tufts University, before the Senate Committee on Finance, *Reforming America's Outdated Energy Tax Code* (September 17, 2014), <http://go.usa.gov/3eEM5> (PDF, 91 KB).

Figure 2.  
**Estimated Allocation of Energy-Related Tax Preferences, by Type of Fuel or Technology, 2016**



Source: Congressional Budget Office, using data from Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2016–2020*, JCX-3-17 (January 30, 2017), pp. 29–30, <http://go.usa.gov/xXBAG>; staff of the Joint Committee on Taxation, "Estimated Budget Effects of Division Q of Amendment #2 to the Senate Amendment to H.R. 2029 (Rules Committee Print 114-40), The 'Protecting Americans From Tax Hikes Act of 2015,'" JCX-143-15 (December 16, 2015), <http://go.usa.gov/xXKNZ>; Department of the Treasury, *Combined Statement of Receipts, Outlays, and Balances* (December 2016), <http://go.usa.gov/xXKN9>; and Office of Management and Budget, *Budget of the U.S. Government, Fiscal Year 2017: Appendix* (February 2016), p. 1025, <http://go.usa.gov/xXKNR>.

This figure includes all of the tax preferences listed in Table 1.

a. Includes the costs of tax preferences related to the transmission of electricity, which are typically small.

### Spending for Department of Energy Programs

In 2016, DOE's funding for basic energy science, energy technologies (including R&D for fossil fuels, nuclear energy, renewable energy, and electricity delivery and reliability), and energy efficiency totaled \$5.9 billion. That total accounts for roughly 20 percent of DOE's 2016 appropriations, the largest shares of which were for

maintaining the U.S. nuclear weapons stockpile and cleaning up former nuclear facilities.

Although other agencies also fund energy-related programs—for example, the Department of the Interior's leasing and resource-management programs and the Department of Agriculture's programs supporting rural electricity production and transmission—the costs of those activities are not included in this analysis.<sup>8</sup> This analysis focuses on expenditures that promote the development of specific fuels or energy technologies or that further the scientific knowledge on which those new technologies rely. Specifically, this analysis includes the funding for basic energy sciences research that is administered through DOE's Office of Science as well as the funding provided through the department's programs for energy technology R&D. Some previous versions of this analysis did not include funding for basic research; here, the historical data include those amounts.

### Historical Trends

Since it was established in 1977, DOE has supported the development of energy technologies primarily by funding R&D and technology demonstration projects aimed at creating new domestic sources of energy. Budget authority—authority provided by appropriation laws to incur financial obligations that will result in outlays of government funds—for DOE's technology programs has varied significantly over the past three decades. In 1985, such programs received budget authority totaling \$6.1 billion, in 2016 dollars (see Figure 3 on page 8). Following a period of substantial investment in the early 1990s, however, the federal government's interest in funding the development of new energy sources waned. By 2000, constant-dollar budget authority for DOE's energy technology and sciences programs had fallen to \$3.3 billion.

In 2009, DOE received \$46.9 billion for support of energy technologies (measured in 2016 dollars and adjusted to account for rescissions and transfers)—roughly 11 times the average annual budget authority for

8. This analysis also excludes government spending for the production of electricity through the Tennessee Valley Authority, the Bonneville Power Administration, and other federal power entities; spending for the Low Income Home Energy Assistance Program; and spending by the Energy Information Administration.

Table 1.

**Energy-Related Tax Preferences, 2016**

Type of Fuel or Technology Supported	Tax Preference	Estimated Total Cost (Billions of Dollars)	Expiration Date
<b>Tax Preferences Affecting Income Taxes</b>			
Renewable Energy	Credits for the production of electricity from renewable resources <sup>a</sup>	3.4	Various <sup>b</sup>
	Credits for investments in solar and geothermal equipment, fuel cells, and microturbines	2.6	Various <sup>b</sup>
	Credit for investment in advanced energy property, including property used in producing energy from wind, the sun, or geothermal sources	0.3	Fixed \$2.3 billion in credit; available until used
	Five-year depreciation for certain renewable energy equipment	0.3	None
Fossil Fuels	Expensing of exploration and development costs for oil and natural gas	1.8	None
	Option to expense depletion costs on the basis of gross income rather than actual costs	0.9	None
	Exceptions for publicly traded partnerships with qualifying income derived from certain energy-related activities <sup>c</sup>	0.9	None
	Amortization of costs of air pollution control facilities	0.5	None
	Credit for investment in clean coal facilities	0.2	Fixed dollar amount of credit; available until used
	15-year depreciation for natural gas distribution lines	0.2	12/31/2010 <sup>d</sup>
	Amortization of geological and geophysical expenditures associated with oil and gas exploration	0.1	None
Energy Efficiency	Residential efficiency property credit	1.1	12/31/2021
	Credit for energy-efficiency improvements to existing homes	0.5	12/31/2016
	Credit for new energy-efficient homes	0.4 <sup>e</sup>	12/31/2016
	Credit for plug-in electric vehicles	0.3	Expires for each manufacturer when the number of vehicles it sells reaches the limit set by the federal government
	Deduction for energy-efficient commercial buildings	0.2 <sup>e</sup>	12/31/2016
	10-year depreciation for smart meters or other devices for monitoring and managing energy use	0.1	None
Electricity	15-year depreciation of certain property related to electricity transmission	0.1	None
Nuclear Energy	Special tax rate for reserve funds for nuclear decommissioning	0.2	None
	Subtotal, Tax Preferences Affecting Income Taxes	14.1	n.a.

Continued

Table 1. Energy-Related Tax Preferences, 2016 Continued

Type of Fuel or Technology Supported	Tax Preference	Estimated Total Cost (Billions of Dollars)	Expiration Date
<b>Tax Preferences Affecting Energy-Related Excise Taxes<sup>1</sup></b>			
Renewable Energy	Biodiesel and renewable diesel credits <sup>2</sup>	3.6	12/31/2016
	Tax incentives for alternative fuels	0.6	12/31/2016
	Subtotal, Tax Preferences Affecting Excise Taxes	4.2	n.a.
<b>Grants in Lieu of Tax Credits Affecting Energy-Related Excise Taxes</b>			
Renewable Energy	Section 1603 grants	0.1	12/31/2011 <sup>3</sup>
<b>All Energy-Related Tax Preferences</b>			
<b>Total</b>		<b>18.4</b>	<b>n.a.</b>

Source: Congressional Budget Office, using data from Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2016–2020*, JCX-3-17 (January 30, 2017), pp. 29–30, <http://go.usa.gov/xXBA6>; staff of the Joint Committee on Taxation, “Estimated Budget Effects of Division Q of Amendment #2 to the Senate Amendment to H.R. 2029 (Rules Committee Print 114-40), The ‘Protecting Americans From Tax Hikes Act of 2015,’” JCX-143-15 (December 16, 2015), <http://go.usa.gov/xXKNZ>; Department of the Treasury, *Combined Statement of Receipts, Outlays, and Balances* (December 2016), <http://go.usa.gov/xXKN9>; and Office of Management and Budget, *Budget of the U.S. Government, Fiscal Year 2017: Appendix* (February 2016), p. 1025, <http://go.usa.gov/xXKNR>.

The estimates of the costs of individual tax preferences do not account for any potential interactions between preferences or include the costs of those tax provisions estimated to result in less than \$50 million in forgone revenues. Nor do they reflect the amount of revenues that would be raised if those preferences were eliminated and taxpayers adjusted their activities in response to those changes.

n.a. = not applicable.

- a. The production tax credits are generally available for 10 years beginning on the date that the facility is put into service.
- b. The credit for the production of electricity from renewable sources and the election to claim the investment tax credit in lieu of the production tax credit is scheduled to expire for wind facilities that begin construction after December 31, 2019. The credit for investments in solar equipment is permanent, with higher rates available for projects under construction by December 31, 2021, and completed by December 31, 2023. The credits for investment in most other renewable energy technologies expired for projects that began after 2016.
- c. This tax preference may be claimed for a variety of activities associated with the production of energy and natural resources; however, on the basis of industry estimates of the size of the industries in which the firms that would qualify for the tax preference operate, CBO expects that most of the \$0.9 billion accrues to firms in the fossil fuel industry.
- d. Effects of the tax preference extend beyond the expiration date.
- e. An estimate for this item was not available. As a proxy for it, CBO used the Joint Committee on Taxation’s estimate of the revenue loss due to the extension of the preferences that was enacted in the Protecting Americans From Tax Hikes Act of 2015 (Division Q of Public Law 114-113).
- f. Neither JCT nor the Administration generally estimates revenues forgone in the excise tax system. They do, however, provide information on revenue reductions from excise tax credits for alcohol and biodiesel.
- g. Estimate includes effects on both income and excise taxes.
- h. Companies that began constructing a facility and applied for the benefit by December 31, 2011, are eligible. Grants are not paid until facilities are placed into service; they are therefore still being disbursed.

the preceding decade. That funding included \$32.0 billion in budget authority provided by ARRA, a onetime appropriation of \$8.4 billion for the ATVM loan program, and \$6.5 billion in regular appropriations.

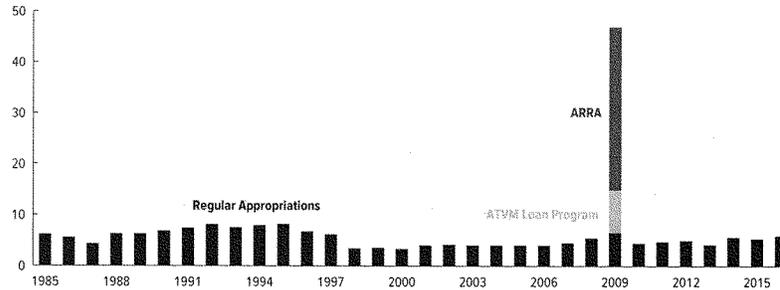
Those ARRA funds have been spent more rapidly than the funds that DOE receives through the normal

appropriation process are typically spent. ARRA specified a deadline of September 30, 2015, for DOE to expend the funds provided under the act, and nearly half of the total outlays occurred within three years of the appropriation. After the expenditure deadline passed, about 12 percent of the ARRA funds for support of energy technologies remained unspent. For example, \$1.5 billion of the

Figure 3.

**DOE's Financial Support for Energy Technologies and Energy Efficiency, 1985 to 2016**

Budget Authority, in Billions of 2016 Dollars



Source: Congressional Budget Office.

The amount indicated for funding provided by the American Recovery and Reinvestment Act of 2009 (ARRA) reflects transfers and rescissions of budget authority for Section 1705 loan guarantees that were made after ARRA was enacted.

ATVM = Advanced Technology Vehicles Manufacturing; DOE = Department of Energy.

\$3.4 billion of budget authority provided by ARRA for demonstration projects related to fossil fuels—mostly to fund partnerships with private electric utilities that would capture and sequester CO<sub>2</sub> emissions from coal-fired electricity generators—remained unspent.

**Financial Support for Energy Technologies in 2016**

The \$5.9 billion appropriated to DOE in 2016 for the development and production of fuels and energy technologies includes both direct investments and credit programs. The direct investments included investments in applied energy research totaling \$4.1 billion and investments in basic energy sciences totaling \$1.8 billion (see Table 2). The credit programs received less than \$50 million in 2016 to cover the administrative costs of overseeing DOE's loan portfolio; no funding was provided for subsidies for new loans.

**Direct Investments.** DOE directly invests in two broad areas of research: Funding for applied energy research is offered through the offices devoted to the different types of energy, such as nuclear or fossil fuels, and funding for basic energy research is provided through DOE's Office of Science.

The \$5.9 billion appropriated for direct investments in 2016 was allocated as follows (see Figure 4):

- 35 percent (or \$2.1 billion) was for energy efficiency and renewable energy. Energy-efficiency programs, which support R&D to improve the energy efficiency of buildings and automobiles and also provide grants for weatherization to improve the energy efficiency of some low-income housing units, account for about 50 percent of all such funding. Renewable-energy programs, which promote the development of solar, biomass, wind, and other renewable energy sources, account for almost 40 percent. The remaining 10 percent goes toward program administration, facilities, and overhead.
- 31 percent (or \$1.8 billion) was for the Basic Energy Sciences program. That funding supports research to provide the scientific foundation or impetus for many of the advances made in each of the applied fields of energy technology. To accomplish that mission, the research is devoted to understanding, predicting, and ultimately controlling matter and energy at the atomic and molecular levels.
- 15 percent (or \$0.9 billion) was for nuclear energy. The nuclear energy program focuses on making reactors safer and cheaper, developing a sustainable nuclear fuel cycle, and maintaining federal nuclear energy research facilities.

Table 2.

**DOE's Support for Energy Technologies and Energy Efficiency, 2016**

	Budget Authority (Billions of dollars)
<b>Direct Investment Programs</b>	
Applied Energy	
Energy efficiency and renewable energy	2.1
Nuclear energy	0.9
Fossil energy research and development	0.6
Advanced Research Projects Agency–Energy	0.3
Electricity delivery and energy reliability	0.2
Subtotal	4.1
Science	
Basic Energy Sciences program	1.8
Subtotal, Direct Investments	5.9
<b>Energy Credit Programs</b>	
Title 17 Innovative Technology Loan Guarantee Program	*
Advanced Technology Vehicles Manufacturing Loan Program	*
<b>Total</b>	<b>5.9</b>

Source: Congressional Budget Office.

DOE = Department of Energy; \* = less than \$50 million.

■ 11 percent (or \$0.6 billion) was for fossil energy R&D programs. DOE's funding for those programs goes primarily to research for technologies aimed at reducing emissions—particularly of CO<sub>2</sub>—from coal-fired electricity generation.

■ 8 percent (\$0.5 billion) was for other purposes, including the Advanced Research Projects Agency–Energy (\$0.3 billion), which funds high-risk research that has the potential for a large payoff in any of the above technological areas, and electricity delivery and energy reliability programs (\$0.2 billion), which support improvements in the electricity grid that allow for increased energy efficiency and additional use of renewable-energy technologies.

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

■ The Section 1703 loan guarantee program—a permanent program aimed at increasing investment

in nuclear facilities or other innovative clean-energy facilities;

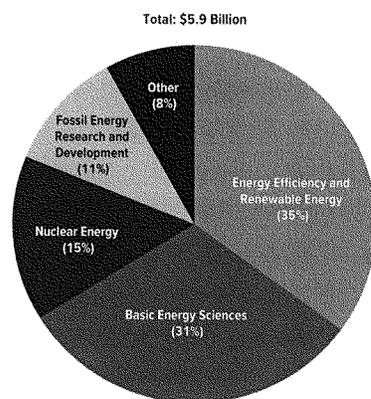
■ The Section 1705 loan guarantee program—a now-expired program that guaranteed loans to support projects developing renewable-energy systems and electric power transmission as well as some innovative biofuel projects; and

■ The Advanced Technology Vehicles Manufacturing loan program—a permanent program intended to improve the energy efficiency of automobiles.<sup>9</sup>

DOE's credit programs provide both subsidized and unsubsidized loans and guarantees. Most of the guarantees authorized under the Section 1703 program (primarily guarantees for loans to nuclear facilities) are intended to be self-supporting; recipients pay a fee designed to cover the government's cost of providing the guarantee, as

9. The Section 1703 and Section 1705 programs are often referred to collectively as the Title 17 program.

Figure 4.  
Allocation of DOE's Direct Investments in  
Energy Technologies and Energy Efficiency, 2016



Source: Congressional Budget Office.

"Other" includes funding for the Advanced Research Projects Agency—Energy and for electricity delivery and energy reliability programs.

DOE = Department of Energy.

estimated under the Federal Credit Reform Act of 1990.<sup>10</sup> In contrast, lawmakers have provided a total of \$9.5 billion (in nominal dollars) in budget authority to subsidize

10. Lawmakers set limits on both the value of loans or loan guarantees that each program can provide and on the government's cost of making those loans, which is referred to as the subsidy cost. Under the Federal Credit Reform Act of 1990, before an agency can make a loan or loan guarantee, lawmakers must provide funding sufficient to cover the subsidy cost minus fees paid by borrowers. The subsidy costs for DOE's loans and loan guarantees are the estimated lifetime costs of the credit assistance, which include losses from defaults net of any recoveries on the loans. Government agencies change their estimates of the risks of default and the consequent budgetary costs of their loans and loan guarantees as they gain more experience with them. As a result, the estimated subsidy costs of federal loans and loan guarantees made under a particular credit program are frequently revised over the life of the program. To reduce the effects of those costs on the federal budget, the federal credit programs that support innovation often require the recipients of loans and guarantees to pay for the expected lifetime costs of the credit.

loan guarantees made under the Section 1705 program (primarily those for renewable energy) and loans made through the ATVM program. All of that budget authority was granted in previous years; no subsidy appropriations were provided for the credit programs in 2016 (although DOE received \$47 million for administrative expenses). DOE has obligated \$4.7 billion of the \$9.5 billion that had been appropriated for subsidy costs.<sup>11</sup> The ATVM loan program continues to accept applications on a rolling basis and has the authority to make more than \$16 billion in new loans as of the end of fiscal year 2016. Also as of then, DOE had about \$26 billion in remaining authority with which to issue loan guarantees under the Section 1703 program.

Between 2009 and 2016, DOE's credit programs provided 38 loans and loan guarantees in support of 30 projects (see Table 3). As of the close of 2016, five of those 38 loans and guarantees were in default. Most of the defaulted loans and guarantees (which were largely for the manufacturing of solar or automotive products) were considered risky at the time they were issued. None of the projects with loans in default had revenue streams that were guaranteed by long-term contracts. In contrast, none of the loans and loan guarantees that *were* backed by long-term contracts have defaulted to date. Those loans and guarantees were for projects undertaken to generate or transmit energy from solar or other renewable sources. Such projects were low risk because they involved contracts—usually with regulated utilities—that guaranteed a market for much of the power produced.

### Cost-Effectiveness of Federal Support

Federal support aimed at promoting the development and use of fuels and energy technologies has been motivated by several goals. Initially, such support was intended to increase domestic production of oil and natural gas. More recently, a growing number of energy subsidies have been aimed at reducing pollution, particularly greenhouse gas emissions. For decades, lawmakers have also sought to promote energy-related R&D that would potentially benefit society as a whole but that the private sector would not undertake without federal support.

11. Estimates of the cost of some obligated subsidies have been subsequently reduced, but those savings are not available for use by the agency.

Table 3.

**DOE's Loan and Loan Guarantee Amounts and Subsidy Rates, 2009 to 2016**

	Section 1703 Loan Guarantee Program for Nuclear and Other Clean-Energy Facilities	Section 1705 Loan Guarantee Program for Renewable Energy and Electricity Transmission	Advanced Technology Vehicles Manufacturing Loan Program
Number of Loans or Loan Guarantees	5	28	5
Total Loan or Loan Guarantee Amount (Billions of dollars)	7.9	13.4	8.1
Disbursements Through 2016 (Billions of dollars)	5.1	13.1	7.3
Original Weighted-Average Subsidy Rate (Percent)	-3.6	12.3	38.2
Reestimated Weighted-Average Subsidy Rate (Percent) <sup>a</sup>	-3.9	12.8	3.4

Source: Congressional Budget Office, using data from the Office of Management and Budget, *Budget of the U.S. Government, Fiscal Year 2017: Federal Credit Supplement* (February 2016), pp. 50, 51, and 75, <http://go.usa.gov/xX8qz>; and additional information from the Department of Energy.

Negative subsidies occur when the present value of cash inflows to the government exceeds the present value of cash outflows.

DOE = Department of Energy.

a. The most recent year for which weighted-average subsidy rates have been reestimated is 2015.

Lawmakers have had multiple tools at their disposal to accomplish those goals. This analysis focuses on tax preferences and spending programs, but lawmakers have also used regulations to obtain the desired outcomes. For example, fuel efficiency standards for vehicles and regulations that require that a specific share of transportation fuels be renewable are aimed at both minimizing U.S. consumers' vulnerability to spikes in oil prices and reducing greenhouse gas emissions.

The existence of multiple goals and policy tools complicates any effort to determine the effectiveness of federal funding. Achieving the goals of one policy may undermine the objectives of another. For example, one solution to U.S. dependence on imported oil in the 1970s was to increase the use of fossil fuels that were plentiful in the United States—namely coal and natural gas—in the production of electricity. But the substitution of coal for oil in electricity generation raised the emissions of carbon dioxide, a greenhouse gas that contributes to climate change. Furthermore, the existence of multiple policies can make it difficult to measure the incremental effects of a single policy. For example, not only were automotive fuel blenders mandated to use renewable fuels, a mandate that they met primarily by using corn ethanol, but they also benefited from a tax credit (now expired) for doing so. Attributing a precise share of the subsequent rise in the use of ethanol to either one of those policies is difficult because they worked in conjunction with each other.<sup>12</sup>

The following discussion—organized according to the three goals described above: boosting domestic production, reducing greenhouse gas emissions, and encouraging R&D—does not provide a comprehensive assessment of the cost-effectiveness of energy tax preferences or of DOE's funding. It does, however, provide examples of types of funding that have and have not been cost-effective.

#### Boosting Domestic Production

U.S. policymakers have long expressed concern about the vulnerability of the United States to disruptions in the supply of oil. That concern has motivated them to institute policies, including several tax preferences, aimed at increasing the domestic production of oil.<sup>13</sup>

Over the past decade, the amount of oil produced in the United States has increased dramatically because of

12. For more information, see testimony of Terry Dinan, Senior Advisor, Congressional Budget Office, before the Subcommittee on Environment and the Subcommittee on Oversight of the House Committee on Science, Space, and Technology, *The Renewable Fuel Standard: Issues for 2015 and Beyond* (November 3, 2015), [www.cbo.gov/publication/50944](http://www.cbo.gov/publication/50944); and Congressional Budget Office, *The Renewable Fuel Standard: Issues for 2014 and Beyond* (June 2014), [www.cbo.gov/publication/45477](http://www.cbo.gov/publication/45477).

13. For a discussion about the effects of increasing domestic oil production on energy security, see Congressional Budget Office, *Energy Security in the United States* (May 2012), [www.cbo.gov/publication/43012](http://www.cbo.gov/publication/43012).

technological developments related to hydraulic fracturing.<sup>14</sup> However, CBO has found that the per-unit cost of the *additional* domestic production of oil spurred by tax preferences over that period has been high. Tax preferences for domestic production (including the option to expense investment costs on the basis of gross income rather than production, as well as the other preferences listed in Table 1 on page 6) have had a very small effect on the amount of domestic oil produced; as a result, measured on the basis of each additional barrel of oil produced, the cost of the tax preferences has been substantial.

Estimates of the cost-effectiveness of tax credits themselves depend on estimates of how responsive domestic oil producers are to changes in prices. Using three estimates of that responsiveness drawn from the research literature, CBO calculated in its 2015 report the following ranges of estimates for the 2005–2014 period:<sup>15</sup>

- Domestic oil production was between 0.4 percent and 0.8 percent greater with the tax preferences than it would have been without them, and
- The cost of the tax preferences was between \$90 and \$200 per additional barrel of domestic oil produced. That cost to the government is in addition to the market price of the oil, which averaged roughly \$80 per barrel during the period.

Those numbers are only rough estimates, and they are sensitive to assessments of firms' responses to cash flow and changes in after-tax prices. CBO is monitoring new work on those topics. Also, effects could vary among different types of producers (integrated oil companies, which both drill for oil and sell refined products, versus nonintegrated companies, whose revenues are primarily derived from drilling, for example) and under different market conditions.

14. See Congressional Budget Office, *The Economic and Budgetary Effects of Producing Oil and Natural Gas From Shale* (December 2014), [www.cbo.gov/publication/49815](http://www.cbo.gov/publication/49815).

15. Congressional Budget Office, *Federal Support for the Development, Production, and Use of Fuels and Energy Technologies* (November 2015), [www.cbo.gov/publication/50980](http://www.cbo.gov/publication/50980).

Other studies have generally reached similar conclusions about the limited response of oil producers to tax policies that support the domestic production of oil. For example, a study by the National Academy of Sciences concluded that eliminating the depletion allowance (one of the tax preferences included in CBO's analysis) would have virtually no effect on the quantity of oil produced domestically.<sup>16</sup> In addition, two studies conducted in 2009 examined the effect of eliminating more than \$30 billion (in 2009 dollars) of tax preferences that oil and natural gas producers would receive between 2010 and 2019. Those analyses assessed a set of tax preferences that was more expansive than the set that CBO examined. For example, those studies included the effect of eliminating oil producers' ability to claim the domestic manufacturing tax deduction—which CBO did not include in its analysis because the deduction is not specifically related to energy—against income derived from the production of oil and gas. Both of the studies concluded that eliminating the preferences would reduce domestic oil production by less than one-half of one percent and would have virtually no effect on the domestic price of gasoline.<sup>17</sup>

Oil producers themselves say that eliminating preferences would have a greater effect on production. An industry-sponsored survey of independent producers (who account for roughly half of all oil production) found that nearly half of respondents indicated that they would reduce their production from marginal wells by at least 20 percent if the percentage depletion allowance was

16. National Research Council, Board on Science, Technology, and Economic Policy, Committee on the Effects of Provisions in the Internal Revenue Code on Greenhouse Gas Emissions, *Effects of U.S. Tax Policy on Greenhouse Gas Emissions* (National Academies Press, 2013), p. 4, [www.nap.edu/catalog/18299](http://www.nap.edu/catalog/18299).

17. Testimony of Alan B. Krueger, Assistant Secretary for Economic Policy and Chief Economist, Department of the Treasury, before the Subcommittee on Energy, Natural Resources, and Infrastructure of the Senate Committee on Finance (September 10, 2009), <http://go.usa.gov/3emv6> (PDF, 87 KB); and testimony of Stephen P. A. Brown, Nonresident Fellow, Resources for the Future, before the Subcommittee on Energy, Natural Resources, and Infrastructure of the Senate Committee on Finance, *An Economic Assessment of Eliminating Oil and Gas Company Tax Preferences* (September 10, 2009), <http://go.usa.gov/3emGW> (PDF, 171 KB).

eliminated.<sup>18</sup> Even so, estimates of such effects that are based on historical data about the relationship between oil prices and crude oil production, like those described in the studies above, tend to be better indicators than surveys of how total domestic production would change if the preferences were eliminated.

Preliminary results from ongoing research suggest two additional factors that influence the cost-effectiveness of the tax preferences.<sup>19</sup> One factor is the way tax preferences reduce or defer a firm's immediate tax burden—which can cause a greater impact on drilling activity than would otherwise be the case because firms value cash more in the present than in the future. However, evidence suggests another factor working in the opposite direction: that the wells initiated in response to those tax incentives are less productive, on average, than wells that firms would have drilled even in the absence of the incentives. The research is ongoing, so its findings have not been incorporated into CBO's estimates, but the agency will continue to monitor it.

Because of the limited production response by oil producers to tax preferences, the amount of revenues forgone per barrel of additional oil produced as a result of those preferences is likely to be high. That cost is also high because it includes the revenues forgone by subsidizing the production of oil that would have occurred even without the tax preferences.

18. Independent Petroleum Association of America, *Profile of Independent Producers, 2012–2013* (2014), p. 14, <http://tinyurl.com/phq3xwa> (PDF, 2.27 MB). Marginal well production accounts for roughly 15 percent of total U.S. oil production, but only independent producers are eligible for the depletion allowance; integrated oil companies are not. Thus, much of the marginal well production is not eligible for the tax preference discussed in the survey. It is difficult, however, to determine the amount of such production that would be eligible because the marginal well production of independent oil producers is not reported separately from that of integrated oil companies. See Independent Petroleum Association of America, *United States Petroleum Statistics, 2014 Data* (June 2015), Tables 4 and 7, <http://tinyurl.com/oi89mq9> (PDF, 1.24 MB). For eligibility regarding tax preferences, see Senate Committee on the Budget, *Tax Expenditures: Compendium of Background Material on Individual Provisions* (December 2012), p. 129, <http://tinyurl.com/mwf42jh> (PDF, 53 MB).

19. See Gilbert Metcalf, *The Impact of Removing Tax Preferences for U.S. Oil and Gas Production* (Council on Foreign Relations Press, August 2016), <http://tinyurl.com/lu6z45r>.

### Reducing Greenhouse Gas Emissions

Beginning in the mid-2000s, lawmakers increased the share of federal funding for energy aimed at reducing the negative effects of energy production and consumption on the environment. In particular, they have provided tax preferences to reduce emissions of greenhouse gases.

The costs associated with greenhouse gas emissions and other forms of pollution are external costs—costs that are borne by society as a whole rather than falling on businesses or households in proportion to their production or consumption.<sup>20</sup> For example, consumption of gasoline or electricity generated from fossil fuels results in the release of carbon dioxide; without government intervention, however, the prices charged for electricity and gasoline do not reflect the damage caused by the CO<sub>2</sub> that is released. As a result, businesses and households lack sufficient incentives to take greenhouse gas emissions into account when deciding what types and quantity of energy to produce and consume.

### Taxing Greenhouse Gas Emissions Versus Subsidizing Alternatives

The most efficient way to reduce the external costs associated with energy—including the damage caused by greenhouse gas emissions—would be to enact policies, such as taxes, that increased the prices of various types of energy to reflect the external costs that their production and use entail. Such policies would be efficient in that they would motivate emission reductions up to the point at which the additional costs of achieving those reductions equaled the benefit (the external costs prevented from being incurred) of achieving them. For example, policymakers could choose to tax fossil fuels on the basis of the CO<sub>2</sub> that is released into the atmosphere when the fuels are burned. 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. Alternatively, policymakers could enact a cap-and-trade program under which the government would set a cap on CO<sub>2</sub> emissions and allow firms (such as oil producers, natural gas refiners, and large electricity generators) to buy and sell rights to those emissions. Such trading would establish a price on emissions. Compared with a tax, a cap-and-trade program would

20. For a more comprehensive discussion of external costs and other types of market failures, see Congressional Budget Office, *Federal Climate Change Programs: Funding History and Policy Issues* (March 2010), [www.cbo.gov/publication/21196](http://www.cbo.gov/publication/21196).

provide more certainty about the quantity of domestic CO<sub>2</sub> emissions but would provide less certainty about the price of those emissions.

In the absence of policies that incorporate the cost of environmental damage into the price of fuels, the government could directly subsidize investment in or use of technologies or fuels with lower external costs; it might help fund improvements in energy efficiency or subsidize the use of renewable energy, for example. However, such subsidies are typically less cost-effective than incorporating external costs into energy prices because they have some combination of the following undesirable effects:

- Subsidies increase government expenditures or reduce revenues, thereby either adding to the deficit or requiring the government to reduce other spending or increase other taxes—possibly some that discourage the productive use of labor and capital—to pay for the subsidies. (For example, the government might choose to raise taxes on labor income; increases in those taxes tend to reduce the amount of time that individuals choose to work.)<sup>21</sup>
- The government may end up paying firms or households to make choices about investment, production, or consumption that they would have made without the subsidies. For example, tax credits for energy-efficient windows might go to homeowners who would have purchased them anyway.
- Subsidies may boost the demand for services that energy is used to provide. For example, by reducing the cost of maintaining a home at a given temperature, subsidies for energy-efficient windows may cause people to set their thermostats higher in the winter, offsetting at least part of the energy savings that would otherwise have been achieved.<sup>22</sup>
- Typically, subsidies support particular technologies, but those technologies may not necessarily provide the

least expensive means of reducing external costs. For example, subsidies could motivate electricity producers to install wind turbines when it would have been more cost-effective for them to achieve reductions in greenhouse gas emissions by making efficiency improvements.

**Studies of the Cost-Effectiveness of Tax Preferences Aimed at Reducing Greenhouse Gas Emissions.** Determining the cost-effectiveness of tax preferences aimed at reducing greenhouse gas emissions is complicated. Researchers must determine how the tax preferences affect the use of various fuels and energy technologies, including how those preferences interact with other existing policies, such as renewable fuel requirements. They must also determine the emissions consequences of changes in the use of various fuels or energy technologies; that determination is in turn complicated by the necessity of accounting for unintended increases in emissions—either in the United States or overseas—that might occur because of price changes resulting from the preferences.

The National Academy of Sciences study mentioned above assessed the effectiveness of tax credits in reducing greenhouse gas emissions. That assessment included a review of the existing literature as well as original analysis based on the authors' own model. The model, which reflected the assumption that all tax policies and relevant regulations would remain in place throughout the analysis period, examined the effect of tax preferences that were in place in 2011 and projected their effects through 2035.

On the basis of that approach, the NAS study concluded that reducing greenhouse gas emissions through tax preferences was costly. Moreover, it found that some preferences can have the unintended effect of increasing greenhouse gas emissions. Specifically, the NAS study found that production and investment tax credits for renewable electricity generation reduced CO<sub>2</sub> emissions

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

22. That reaction is commonly called the rebound effect. See David Austin, *Addressing Market Barriers to Energy Efficiency in Buildings*, Working Paper 2012-10 (Congressional Budget Office, August 2012), [www.cbo.gov/publication/43476](http://www.cbo.gov/publication/43476). See also Lorna A. Greening, David L. Greene, and Carmen Difiglio, "Energy Efficiency and Consumption—the Rebound Effect—a Survey," *Energy Policy*, vol. 28, nos. 6–7 (June 2000), pp. 389–401, [http://dx.doi.org/10.1016/S0301-4215\(00\)00021-5](http://dx.doi.org/10.1016/S0301-4215(00)00021-5).

at an average cost of \$250 per ton.<sup>23</sup> By comparison, the Environmental Protection Agency (EPA) and other federal agencies recently estimated that the value of damage avoided by a one-ton reduction in CO<sub>2</sub> emissions is \$40 to \$65.<sup>24</sup>

The high cost of reducing emissions through tax preferences has two causes. First, production and investment tax credits have been substantial, amounting to roughly 20 percent of the price of electricity or 30 percent of the initial investment in the generation facility. Second, although some investments in generation from renewable sources have responded to tax credits, the NAS study concluded that a substantial share of the increase in renewable power generation would have occurred even without the tax credits because states have set requirements for such production.<sup>25</sup>

The NAS study also examined the effects of tax credits for renewable transportation fuels. In that case, it found that the credits actually *increased* greenhouse gas emissions. It attributed that counterintuitive result to the fact that the tax credits for renewable fuels reduced the price—and thus increased the consumption—of motor fuels. That increase in turn outweighed any beneficial emission effects of blending renewable fuels in with gasoline or diesel fuel.<sup>26</sup>

In making that calculation, the NAS study panel assumed that each gallon of biofuel reduced greenhouse gas

emissions by the amount necessary to meet the minimum requirements of EPA's Renewable Fuel Standard (RFS) program, which requires that a certain quantity of renewable fuels be blended into the transportation fuel supply each year.<sup>27</sup> For example, to qualify for use in meeting the RFS, each gallon of corn ethanol produced at facilities constructed after December 20, 2007, must reduce emissions by at least 20 percent when used instead of gasoline. However, the actual effect on emissions of substituting biofuels for fossil fuels is unclear. Estimating those effects is complicated by the difficulty of determining the emission consequences of changes in land use and fertilizer use that might have been triggered by increases in the production of renewable fuels.<sup>28</sup> Researchers who have sought to measure those effects have reached different conclusions: Some have found that the production and use of biofuels led to higher emissions than the fossil fuels that they replaced, and others have concluded that biofuels reduced emissions by more than the EPA thresholds.

#### Promoting R&D

Promoting energy-related research and development through federal subsidies has long been a goal of lawmakers. Knowledge created by investments in R&D—whether for energy sciences or energy technologies—may yield benefits for society that often do not translate into profits for the innovating firm. Therefore, without government support, the amount of such research undertaken by the private sector is likely to be inefficiently low. Such benefits are typically largest from basic research, which can lead to general scientific knowledge that cannot be patented, and they tend to diminish as technologies approach commercial production, when individual firms can largely appropriate the benefit.

Although a comprehensive review of the effectiveness of federal funding of energy-related R&D is beyond the

23. National Research Council, Board on Science, Technology, and Economic Policy, Committee on the Effects of Provisions in the Internal Revenue Code on Greenhouse Gas Emissions, *Effects of U.S. Tax Policy on Greenhouse Gas Emissions* (National Academies Press, 2013), p. 70, [www.nap.edu/catalog/18299](http://www.nap.edu/catalog/18299); and Brian C. Murray and others, "How Effective Are US Renewable Energy Subsidies in Cutting Greenhouse Gases?" *American Economic Review*, vol. 104, no. 5 (May 2014), p. 572, <http://dx.doi.org/10.1257/aer.104.5.569>.

24. Other estimates, representing the extremes of the possible distribution of costs or cases in which future costs are discounted at higher rates, are higher or lower. See Environmental Protection Agency, "The Social Cost of Carbon" (accessed March 17, 2017), [www.epa.gov/climatechange/social-cost-carbon](http://www.epa.gov/climatechange/social-cost-carbon).

25. One area in particular that has been found to be responsive to tax preferences is wind generation. See Gilbert E. Metcalf, "Investment in Energy Infrastructure and the Tax Code," in Jeffrey R. Brown, ed., *Tax Policy and the Economy*, vol. 24 (University of Chicago Press, 2010), pp.1–33, [www.nber.org/chapters/c11968](http://www.nber.org/chapters/c11968).

26. National Research Council, Board on Science, Technology, and Economic Policy, Committee on the Effects of Provisions in the Internal Revenue Code on Greenhouse Gas Emissions, *Effects of U.S. Tax Policy on Greenhouse Gas Emissions* (National Academies Press, 2013), p. 6, [www.nap.edu/catalog/18299](http://www.nap.edu/catalog/18299).

27. *Ibid.*, p. 96. The NAS study panel conducted sensitivity analysis using a range of estimates about the effects of biofuel use on emissions, but that analysis did not separate the effects of the tax credits from the effects of the Renewable Fuel Standard program.

28. See Congressional Budget Office, *The Renewable Fuel Standard: Issues for 2014 and Beyond* (June 2014), [www.cbo.gov/publication/45477](http://www.cbo.gov/publication/45477).

scope of this analysis, CBO has concluded that energy-related R&D funded by DOE has had mixed results; nevertheless, technologies created by DOE-funded projects have transferred to private firms at a relatively high rate compared with R&D funded by other federal agencies.

**The Effect of DOE's Funding on Innovation.** Assessing the benefits of basic science research is difficult because the knowledge can be used in a wide variety of often unforeseen ways and because there can be significant lags in time between when the research is conducted and when the knowledge is used. Nevertheless, one early study suggests that the benefits of federally funded basic research have been substantial.<sup>29</sup>

Assessing the returns from more applied research is somewhat less challenging. One comprehensive review finds that the returns from DOE's funding of research for technology development have been uneven.<sup>30</sup> That pattern of uneven economic returns is common in the R&D process and is the consequence of the many risks involved: Most R&D projects, large or small, provide only small benefits to society, if any at all, but a few projects yield very large benefits. Investing in a wide portfolio of many projects may mitigate the risks of R&D more than investing in a few large projects.<sup>31</sup>

In general, funding for the early stages of developing new technologies, such as research that provides a better understanding of materials or underlying physical processes, has been more likely to yield benefits in excess of costs than has funding for the commercial demonstration

of large integrated systems, such as projects demonstrating technological innovations in the generation of electrical power. Early-stage technology development programs, often in energy efficiency, regularly returned economic benefits that exceeded their costs by substantial amounts. Specifically, DOE-funded R&D on refrigeration, electronic ballasts for lights, compact fluorescent lights, low-emission windows, and improvements in oil field technology have yielded positive net benefits.<sup>32</sup> Not only can federal agencies play a pivotal role in increasing the understanding of physical phenomena that are critical to the development of new technology, they can also serve as the repositories of technical expertise and specialized instruments.

In contrast, many large energy technology demonstration projects undertaken in the 1970s and 1980s produced returns that fell short of their costs. DOE has generally been unsuccessful at lowering costs by funding large demonstration projects, for two reasons. First, federal agencies, including DOE, typically do not have an advantage in lowering production costs.<sup>33</sup> In most cases, industrial costs decline only when industries begin producing in substantial volumes, and such costs might even rise with the first few projects. Second, DOE's handling of large demonstration projects has been questionable in the past; the Government Accountability Office and others have long criticized DOE for poor management of such projects.<sup>34</sup>

The potential for technology demonstration projects funded by DOE to lower production costs of new electricity-generating technologies in future years could also be curtailed by the limited demand for new capacity in the industry. The Energy Information Administration forecasts that additions to capacity for electricity

29. See Edwin Mansfield, "Academic Research and Industrial Innovation," *Research Policy*, vol. 20, no. 1 (February 1991), [http://dx.doi.org/doi:10.1016/0048-7333\(91\)90080-A](http://dx.doi.org/doi:10.1016/0048-7333(91)90080-A). The Mansfield study addressed the benefits of academic research in general rather than just energy-specific research. See Congressional Budget Office, *A Review of Edwin Mansfield's Estimate of the Rate of Return From Academic Research and Its Relevance to the Federal Budget Process* (April 1993), [www.cbo.gov/publication/16596](http://www.cbo.gov/publication/16596).

30. National Research Council, Board on Energy and Environmental Systems, Committee on Benefits of DOE R&D on Energy Efficiency and Fossil Energy, *Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000* (National Academies Press, 2001), [www.nap.edu/catalog/10165](http://www.nap.edu/catalog/10165).

31. For a broader discussion of the role of federal R&D in innovation, see Congressional Budget Office, *Federal Policies and Innovation* (November 2014), pp. 9–16, [www.cbo.gov/publication/49487](http://www.cbo.gov/publication/49487).

32. National Research Council, Board on Energy and Environmental Systems, Committee on Benefits of DOE R&D on Energy Efficiency and Fossil Energy, *Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000* (National Academies Press, 2001), [www.nap.edu/catalog/10165](http://www.nap.edu/catalog/10165).

33. Congressional Budget Office, *Federal Efforts to Reduce the Cost of Capturing and Storing Carbon Dioxide* (June 2012), [www.cbo.gov/publication/43357](http://www.cbo.gov/publication/43357).

34. 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](http://www.gao.gov/products/GAO-07-518).

generation in the United States are expected to be lower in the coming decades than in the recent past.<sup>35</sup>

**The Effect of DOE's Funding on Technology Transfer to Private Firms.** To leverage federal investments in R&D and to ensure that technology developed using federal funds reaches the wider public, federal R&D agencies are encouraged to partner with other agencies, universities, and private firms. Aggregate statistics from DOE suggest that some of the technology developed by the department (including all of its programs, not just the offices responsible for applied research into each specific energy type) is of particular use to private-sector entities.

Although there are many metrics by which to evaluate the transfer of technology from federal agencies to private firms, DOE accounts for a disproportionately large share in at least two categories. In 2013, DOE accounted for 59 percent of all active licenses for government technology.<sup>36</sup> It also accounted for a disproportionate share—21 percent—of federal income from all active licenses,

35. Energy Information Administration, "Projected Electric Capacity Additions Are Below Recent Historical Levels," *Today in Energy* (May 11, 2015), [www.eia.gov/todayinenergy/detail.cfm?id=21172](http://www.eia.gov/todayinenergy/detail.cfm?id=21172).

36. National Institute of Standards and Technology, *Federal Laboratory Technology Transfer, Fiscal Year 2013: Summary Report to the President and the Congress* (October 2015), pp. 8–10, 68–70, <http://go.usa.gov/xBAc> (PDF, 4.5 MB). The statistics presented are for DOE as a whole. DOE has not published technology transfer data that would allow CBO to distinguish between DOE's activities in energy, science, and nuclear programs.

despite the fact that it accounted for only 8 percent of federal obligations for R&D in 2013.<sup>37</sup>

The department's other metrics of technology transfer are not as exceptional. DOE's share of collaborative relationships with nonfederal entities is not particularly large; it accounted for only 9 percent of cooperative research and development agreements between federal laboratories and nonfederal entities in 2013.

This testimony updates *Federal Support for the Development, Production, and Use of Fuels and Energy Technologies*, a report that the Congressional Budget Office released in November 2015. The report was updated for this testimony by David Austin, Mark Booth, Megan Carroll, Terry Dinan, Kathleen Gramp, Peter Huether, and David Wylie with guidance from Joseph Kile. In keeping with CBO's mandate to provide objective, impartial analysis, neither the report nor the testimony contains any recommendations.

Mark Hadley and Jeffrey Kling reviewed the testimony. It is available on CBO's website at [www.cbo.gov/publication/52521](http://www.cbo.gov/publication/52521).

37. By comparison, the Department of Defense and the National Institutes of Health accounted for 73 percent of federal R&D obligations in 2013. See National Science Foundation, *Federal Funds for Research and Development: Fiscal Years 2013–15*, Detailed Statistical Tables NSF 15-324 (June 2015), [www.nsf.gov/statistics/2015/nsf15324/](http://www.nsf.gov/statistics/2015/nsf15324/).

Mr. UPTON. Thank you.  
Dr. Murphy.

**STATEMENT OF ROBERT P. MURPHY**

Dr. MURPHY. I would like to thank Chairman Upton, Congressman McNerney, and the other members of the subcommittee for the opportunity to speak on this important topic concerning Federal tax policy and its effects on energy markets and consumers.

When it comes to assessing tax policy, economists generally focus on the ways the tax code distorts behavior. There is a general presumption in favor of letting market prices guide the decisions of producers and consumers so that resources are allocated according to the underlying economic realities. When the tax code artificially steers behavior away from the market outcome, this makes society poorer.

A textbook example of such harms is the distortions caused by an income tax. By artificially reducing the reward to earning wages, the income tax discourages work effort. On top of that an income tax also leads individuals to save less because the income earned from saving is itself taxed. The income tax thus makes society poorer by both reducing work and reducing investment.

Now, although economists disagree about the proper size of government, there is a general consensus that if the Government is going to raise a target amount of revenue through a percentage tax, then the way to minimize the economic fall is applying that tax on as wide of a base as possible in order to keep the rate of the tax as low as possible. Now, to be sure, there is other goals of tax policy besides economic efficiency, but in terms of minimizing the distortion of behavior the tax code would apply the same tax rate to all sectors of the economy and would contain no arbitrary deductions or credits that favor one group over another.

Now, I should clarify that the principle here is no arbitrary deductions. I bring this up because some proposals for tax reform want to take away the deductibility of interest expenses, an option that currently gives companies an incentive to engage in debt finance relative to equity finance. But to me it seems this has things backwards. After all, a company's interest payments really are expenses to the company. The real source of the distortion is the currently high corporate income tax rate of 35 percent; lowering that rate would alleviate this particular distortion.

Now, when it comes to energy markets there are many provisions of the tax code that violate these general principles I have discussed. That is to say the tax code currently has many provisions that are specifically designed to favor certain sectors of the energy market. Society ends up producing energy using more resources than it needs to because the tax code artificially hides the true cost of less efficient energy sources.

The best example of such a distortion occurs in the electricity market where there can be long stretches of negative wholesale prices. Wind operators will pay the grid to buy electricity from them with the price sometimes falling below \$20 per megawatt hour. The reason for this strange occurrence is the generous production tax credit, which currently gives the owners of wind facilities a tax credit of \$23 for every megawatt hour they produce. This

can make it profitable at the individual level to sell wind power even at negative prices, but of course from the perspective of society as a whole this is clearly a perverse outcome that would not occur on a normal market.

The Congressional Research Service recently estimated the implicit expenditures in the tax code for energy-specific provisions. It found that the production tax credit was the most expensive at a projected cost of \$25.7 billion from 2016 through 2020. The second most expensive provision was the related investment tax credit also designed for renewable energy sources at a cost of 13.6 billion. These two provisions alone accounted for almost 48 percent of the total energy-tax advantages analyzed in this particular report. By artificially encouraging the expansion of wind and solar capacity, current tax policy makes energy production less efficient.

Now, some have argued that wind and solar are infant industries that need support from the tax code, but these arguments have been around for decades. At this point wind and solar are not infants, they are grown adults. If they can currently only serve niche markets, that is the economic reality.

It is also worth addressing the distributional consequences of some of these particular tax measures. So, for example, a 2015 study by UC Berkeley found that for the particular measures trying to reward consumers for buying electric vehicles, 90 percent of the credits went to filers earning above \$75,000 per year, and 35 percent of this particular tax credit was claimed by people earning above \$200,000 per year.

A more consistent, neutral tax code would let producers and consumers choose the mix of energy sources that made the most economic sense. Energy would be produced at the lowest cost, freeing up resources to increase output in other areas of the economy giving Americans more reliable energy and a higher standard of living. Thank you, and I look forward to answering your questions.

[The prepared statement of Dr. Murphy follows:]

**IER** INSTITUTE FOR  
ENERGY RESEARCH**BEFORE THE  
HOUSE COMMITTEE ON ENERGY AND COMMERCE  
SUBCOMMITTEE ON ENERGY****FEDERAL ENERGY RELATED TAX POLICY  
AND ITS EFFECTS ON MARKETS, PRICES, AND CONSUMERS****MARCH 29, 2017****TESTIMONY OF ROBERT P MURPHY, PHD  
SENIOR ECONOMIST, 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.

**Executive Summary**

Economists generally agree that decentralized markets, operating through private property and the profit-and-loss test, allocate resources better than top-down central planning. In the context of tax policy, this principle means that policymakers should try to raise the desired amount of revenue in a manner that distorts consumer and producer behavior as little as possible.

This principle is routinely violated when it comes to tax policy and energy markets. A recent study estimates that from 2016-2020, the federal tax code will provide artificial support through energy-specific provisions that cost the Treasury (in the form of forfeited revenues) \$82.7 billion, with the renewables provisions of the Production Tax Credit and Investment Tax Credit holding the #1 and #2 spots, receiving 47.5% of the total subsidy between them.

According to the Energy Information Administration (EIA), in Fiscal Year 2013 direct federal financial interventions (a measure that includes, but is not limited to, tax expenditures) for

electricity production directed \$5.9 billion to wind and \$4.4 billion to solar, yet only \$901 million for coal and \$690 million for natural gas and petroleum electricity production. The difference in federal support is even more striking when adjusted for the level of output: On a per-megawatt-hour basis, in FY 2013 solar received \$231 of support and wind received \$35, while natural gas and petroleum received 67 cents and coal received 57 cents.

As these figures amply demonstrate, federal tax policy currently provides artificial encouragement to some sectors (such as wind and solar) at the expense of other energy sources. The popular slogan “all of the above” to characterize a sensible U.S. energy policy is defensible, if it means that policymakers will foster a level playing field. Artificially promoting the development of wind and solar actually raises the true cost of electricity generation, because it is currently much cheaper to produce electricity (all things considered) through coal and natural gas plants, rather than new wind and solar.

As these newer technologies develop, the market may gradually shift to a greater reliance upon them. However, if policymakers continue to use the tax code (as well as direct spending and regulations) to artificially promote the expansion of some energy sources, this will further distort behavior, reducing consumer welfare and in particular making the energy sector less efficient.

### **Introduction**

Policymakers, members of the public, and even late-night comedians recognize there are problems with the current U.S. tax code. As a bipartisan presidential panel on tax reform concluded in 2005:

If you were to start from scratch, the current tax code would provide a guide on what to avoid...[W]e have a tax code that distorts basic economic decisions, sets up incentives for unwise or unproductive investments, and induces people to work less, save less, and borrow more. By some estimates, this economic waste may be as much as \$1 trillion each year.<sup>1</sup>

One example that economists often use to show how the tax code perversely encourages borrowing is the corporate tax treatment of debt versus equity finance. “[U]nder the U.S. tax system, corporations may deduct payments of interest from taxable income, but are not allowed to deduct dividends. The tax law therefore builds in a bias towards debt financing.”<sup>2</sup>

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<sup>1</sup> President’s Advisory Panel on Federal Tax Reform, 2005, p. 1, quoted in Harvey S. Rosen and Ted Gayer, *Public Finance* (New York: McGraw-Hill/Irwin), 9<sup>th</sup> edition, 2010, p. 477.

<sup>2</sup> Rosen and Gayer, *Public Finance*, p. 450.

However, although such commentary is common—and is very useful to get the general public as well as policymakers to see the way the tax code encourages behavior (in this case, a reliance on debt versus equity financing) that many see as undesirable—the “solution” often advanced is arguably a cure worse than the disease. Specifically, many tax reform proposals would deal with this problem by eliminating a firm’s ability to deduct interest payments from its taxable income. Yet this suggested fix doesn’t really match the tax treatment to the accounting realities; after all, from a company’s perspective, interest payments to bond holders *are* a business expense, just as surely as wage payments to employees.

Rather than saying, “By allowing the deductibility of interest expense, the tax code artificially favors debt finance,” it would be more accurate to say, “By taxing net income, the corporate tax artificially penalizes equity finance.” In any event, economists generally agree that the *high rate of U.S. corporate income taxation*—currently the highest among advanced economies and one of the highest in the world<sup>3</sup>—distorts business decisions, including the method of financing. This effect is by no means trivial: A 2001 academic study by Gordon and Lee estimated that “lowering the corporate [tax] rate by 10 percentage points lowers the percentage of the firm’s assets financed by debt by 4 percent.”<sup>4</sup>

As this discussion indicates, the U.S. federal tax code has the power not simply to raise revenue for the government, but also to alter behavior by households and firms. Generally speaking, it is economically undesirable for members of the private sector to make decisions because of the tax code. Yet we have also seen that having a broad economic framework for interpreting the impacts of the tax code is also important, lest policymakers tweak the code to address a specific problem in ways that simply invite further difficulties down the road.

The distortions emanating from the tax code occur across the economy, but our topic in this analysis is the impact on energy markets in particular. Yet before we discuss this narrower field, we should first provide a general framework of the economic analysis of taxes.

### **General Principles in the Economic Analysis of the Tax Code**

Before analyzing the specifics of U.S. federal tax policy and its effects on energy markets, we should first provide a general framework for the economic analysis of the tax code. Although

<sup>3</sup> Kyle Pomerleau, “Corporate Income Tax Rates around the World, 2016,” Tax Foundation, August 18, 2016, available at: <https://taxfoundation.org/corporate-income-tax-rates-around-world-2016>.

<sup>4</sup> The quotation is from Rosen and Gayer, *Public Finance*, p. 451. They are referring to Roger H. Gordon and Young Lee, “Do Taxes Affect Corporate Debt Policy? Evidence from U.S. Corporate Tax Return Data” (2001), *Journal of Public Economics* 8: 195-224.

economists would differ in the importance they might attribute to each of the considerations in this section, the principles we discuss here are standard in this literature.<sup>5</sup>

*The Economic Harm of an Inefficient Tax*

Although the press often reports on tax code changes in terms of dollars—e.g. a “\$240 billion tax hike over ten years”—academic economists usually have something else in mind when they discuss the economic harm or damage of the tax code. It is not the mere transfer of purchasing power from the taxpayers to the government that is the issue; after all, perhaps the government in principle could spend the money on something socially useful. Rather, when economists talk about the inefficiency of the tax code, they usually mean that it is *distorting behavior* away from the optimal patterns that would exist in the absence of tax incentives.

Among economists there is a default presumption in favor of allocating resources *not* through top-down, command-and-control policies, but rather through the decentralized decisions of consumers and firms operating in the context of a market economy with private property rights and freely floating prices. To be sure, any economics textbook could list specific areas in which the “free market outcome” might need to be augmented because of imperfections, but nonetheless there is a general presumption in favor of letting consumers and entrepreneurs “spontaneously” determine how society’s scarce resources (including workers’ labor hours) will be allocated among specific industries. The market’s profit-and-loss test—operating on the basis of the “true” prices reflecting genuine scarcity—is the feedback mechanism by which resources are channeled into their most valuable uses.

Absent a compelling reason to doubt the market outcome in a particular case, as a general rule it will reduce the efficiency of the economic system when the tax code distorts incentives and leads consumers and producers to behave differently. To repeat, this is a different concept from the mere amount of tax revenues raised by a certain tax. For example, a \$1 per box tax on Cheerios might raise the same total tax receipts as (say) a nickel tax on *all* cereal boxes, but most economists would consider the latter approach to be much more sensible, since it would raise the revenue in a way that did not distort consumer choices nearly as much.

When a tax causes individuals to alter their behavior in inefficient ways, the result is a *deadweight loss* to society; the private sector ends up poorer, not just because of the immediate loss of tax payments to the government, but also because tradeoffs have been artificially distorted by the tax code.

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<sup>5</sup> For a textbook reference on the general discussion in this section, see Harvey S. Rosen and Ted Gayer, *Public Finance* (New York: McGraw-Hill/Irwin), 9<sup>th</sup> edition, 2010, especially chapters 15-17, 19, and 21.

Economists quantify a particular tax's inefficiency according to its *excess burden*, which means the *extra* amount by which the taxpayer is made poorer, in order to transfer a particular amount of revenue to the tax collector. Economists differ widely in their estimates of the excess burden of U.S. taxation, but one 2006 analysis from an expert in the field concluded that it cost the private sector \$1.75 for every \$1 raised in government revenue.<sup>6</sup>

*Examples of Economic Distortions Arising from the Tax Code*

By artificially penalizing (or rewarding) certain behaviors, the tax code can distort activity and (in general) reduce economic efficiency. These distortions can take place on many fronts.

For example, because the tax code typically focuses on market exchanges, it distorts the tradeoff between labor and leisure. Consider a worker who earns \$50 per hour of labor. Absent any tax considerations, the worker will supply additional labor hours until the point at which he values (on the margin) an hour of leisure more than the extra goods and services he could obtain with an additional \$50. However, if there is a 10 percent sales tax, then an extra \$50 in hand will really only yield approximately an extra \$45 worth of goods and services to the worker. This will artificially reduce the attractiveness of selling labor time for wages, and will (other things equal) lead workers in the aggregate to consume more leisure, i.e. to work fewer hours.

For another example, consider an income tax. Like a sales tax, it too distorts the labor/leisure decision and reduces the attractiveness of working. However, a typical income tax contains the *additional* distortion that it artificially penalizes saving. Consider a worker who earns \$10,000 in gross income, when interest rates are 3%. In the absence of any taxation, the worker can consume her income today and enjoy \$10,000 worth of goods and services. Or, she can save her money for a year, earn an additional \$300 in interest income, and enjoy \$10,300 in goods and services next year. But with a 10% income tax, the tradeoff becomes \$9,000 in enjoyment today versus \$9,243 in enjoyment next year. Instead of reaping the full  $\$9,000 \times 3\% = \$270$  in interest income as a reward for her year of abstinence, the worker is now only gaining an extra \$243 in consumption by waiting for a year, because the gross interest income of \$270 ( $= \$9,000 \times 3\%$ ) was also taxed at 10%, meaning an extra \$27 went to the government on top of the original \$1,000 income tax paid on the \$10,000 in wage income. Thus, this worker is less likely to work, and on top of that is less likely to save, because of the artificial distortion of the income tax.

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<sup>6</sup> The 75 percent estimate comes from Martin Feldstein, "The effects of taxes on efficiency and growth" (2006), NBER Working Paper No. 12201. Feldstein's result and a broader discussion can be found in James R. Hines Jr., "Excess Burden of Taxation" (2007), Office of Tax Policy Research, University of Michigan Ross School of Business, May 31, 2007, available at: <http://www.bus.umich.edu/otpr/WP2007-1.pdf>.

*Minimizing the Excess Burden of Taxation*

If the goal were to raise a given amount of revenue with as little distortion as possible, one solution would be to impose an equal, lump-sum head tax on every citizen. For example, if the government wanted to raise \$3.3 trillion in revenue, and we assume there are 330 million identifiable people in the United States, then one possible tax system would simply assign a tax bill of \$10,000 to every man, woman, and child in the country. If this were feasible, it would raise (roughly) the same amount as the current tax code but with hardly any distortion, because Americans' tax bill would have nothing to do with their behavior (except perhaps for the decision to remain within the United States).

However, most people—including economists—recognize that such an approach, although very efficient, violates the principle of tax *equity*. One obvious consideration when it comes to equity is “ability to pay”; most people think a billionaire should pay more dollars in tax than someone with no income or assets.

In this document, it is not my purpose to argue for a particular “optimal” design of tax policy. There are competing principles at stake, such as the tradeoff between efficiency and equity, as well as the broader, more philosophical questions of the proper size of government and the proper amount of resources to be transferred to the political sector away from the private sector.

Although we will not seek to answer these difficult questions here, even so we can (in the remainder of this subsection) consider methods of reducing the excess burden of taxation, i.e. ways of making the tax code more efficient. Then in later sections we apply our discussion to the case of energy markets.

A standard goal for minimizing inefficiency is to keep tax *rates* as low as possible, by applying them to as wide a base as possible. If we are to have an income tax, this means consolidating the number of tax *brackets* and *reducing arbitrary deductions<sup>7</sup> and credits* currently available. The logical end result of this approach would be a single, flat tax applied uniformly to the properly calculated net income of the entity.<sup>8</sup>

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<sup>7</sup> It is important to note the word “arbitrary” in our statement. If a business is being taxed on its net income, it is perfectly sensible to allow the business to deduct its legitimate business expenses and thus reduce its taxable income. Part of the difficulty in tax reform is the treatment of household expenditures. When a household buys a new car, is that an investment or consumption?

<sup>8</sup> A classic case for a single rate flat tax is Robert E. Hall and Alvin Rabushka, *The Flat Tax* (Hoover Institution), 2<sup>nd</sup> edition, 2007, available at: <http://www.hoover.org/research/flat-tax>. Note, however, that by allowing for the full deductibility of investment expenditures, the Hall/Rabushka flat tax is essentially a consumption tax, not an income tax.

The direct benefit of such a tax code is that it raises the target amount of revenue with the smallest top marginal tax rate (by using a single rate and the broadest possible base). Thus it minimizes the distortions we have discussed, on the leisure-labor and consumption-saving decisions. In other words, such a tax would reduce the current penalties on working and investment.

Beyond this direct benefit, there would also be economic gains in the form of the reduced compliance costs. Without myriad deductions and credits, households and firms would no longer need to retain as much paperwork, and would also save an extraordinary amount of time—both their own and the time outsourced to tax professionals—with a much simpler tax code.

Finally, if households and businesses knew that there was a firm commitment to simplicity in the tax code, they would reduce the amount of resources devoted to *rent seeking*. Currently, the tax code contains high (some might argue punitive) marginal rates as the default, but with many deductions and credits that favor particular groups or activities, thus shielding them from the high rates. But when the tax code implicitly “picks winners and losers,” not only does this directly distort behavior, but it also makes it worthwhile for various groups to spend resources lobbying policymakers to tweak the tax code in ways favorable to them. Although these efforts are rational at the individual level, in the aggregate they are largely an “arms’ race” that renders the resulting tax code even worse from an efficiency standpoint. A truly simple tax code would reduce the resources spent on such efforts. Resources would be allocated primarily through the incentives given by market prices, not the tax code.

This brief discussion has distilled some of the key principles of tax analysis from an academic economics perspective. In the real world, there are other considerations besides “textbook” efficiency (and equity). For example, a tax “reform” package might introduce new taxes that in theory are more efficient while phasing out other taxes. On paper this would seem to be a desirable change, but if in reality policy makers reintroduced the original tax *on top* of the new additions, then the result could be worse than the status quo.

Despite these difficulties, the framework we have presented summarizes some of the key lessons from economists on tax policy. We now apply this framework specifically to the tax code and energy markets.

#### **THE U.S. FEDERAL TAX CODE AND ENERGY MARKETS**

The general principles we discussed above apply to energy markets. For example, it is popular to endorse an “all of the above” approach to the various sources of energy production. We agree, but note that this does *not* mean that the tax code (or regulatory policy) should be designed with the intention of *promoting* certain energy sources while penalizing others.

Instead, an appropriate “all of the above” approach means setting a uniform playing field, with as low a tax rate as possible applied evenly to as broad a base as possible, so that the target amount of revenue is raised while minimizing the distortion of behavior. Just as consumer choice, guided by market prices, leads to the allocation of resources among different types of restaurants, so too should consumers ultimately be the ones to determine the market’s mix of energy sources.<sup>9</sup>

In the remainder of this document we summarize some of the key facts concerning the tax treatment of the energy sector, and how this distorts markets and reduces consumer well being.

### **Energy Information Administration (EIA) Assessment of Energy “Subsidies” as of FY 2013**

The Energy Information Administration (EIA), an independent agency within the Department of Energy (DOE), in 2015 issued a report on the “direct federal financial interventions and subsidies that are provided by the federal government, provide a financial benefit with an identifiable federal budget impact, and are specifically targeted at energy markets,” for Fiscal Year 2013.<sup>10</sup> The term “subsidy” here is construed broadly, and includes not only direct cash assistance but also preferential treatment in the tax code that reduces an entity’s tax liability.<sup>11</sup> We present some of EIA’s key findings below.

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<sup>9</sup> We deal with possible objections to such a strategy—such as the “market failure” argument in the context of carbon dioxide emissions and climate change—below.

<sup>10</sup> Energy Information Administration, “Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2013,” March 12, 2015, available at: <https://www.eia.gov/analysis/requests/subsidy/>.

<sup>11</sup> The EIA report notes (p. xi) that because it focuses on measures that are specifically targeted to the energy sector, its analysis does not include *all* federal provisions that might benefit the energy sector. For example, “Section 199 of the American Jobs Creation Act of 2004, referred to as the domestic manufacturing deduction, provides reductions in taxable income for American manufacturers, including domestic oil and gas producers and refiners.” In later sections we address some of the popular complaints about the “tax breaks” given to the oil industry.

Table 1. Value of Energy Subsidies By Major Use, FY 2010 and FY 2013 (millions of 2013 dollars)

<b>Subsidy and Support Category</b>	<b>FY 2010</b>	<b>FY 2013</b>
<b>Electricity-Related</b>	<b>11,694</b>	<b>16,112</b>
Fuel and Technologies Used for Electricity Production	10,862	14,928
Transmission and Distribution	833	1,184
<b>Fuels Used Outside the Electric Power Sector</b>	<b>10,710</b>	<b>5,206</b>
<b>Conservation, End Uses, and Low-Income Home Energy Assistance Program (LIHEAP)</b>	<b>15,574</b>	<b>7,940</b>
Conservation	7,069	1,964
End Uses and Other Technologies	3,127	2,860
LIHEAP	5,378	3,116
<b>Total</b>	<b>37,979</b>	<b>29,258</b>

Source: EIA (2015), "Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2013," Table ES1.

As Table 1 indicates, as of FY 2013 EIA had cataloged some \$29 billion in direct federal financial intervention in energy markets, with \$16 billion going to electricity, \$5 billion going to other fuels, and just under \$8 billion going to conservation, end uses, and low-income energy assistance.

We now break down the totals by energy type.

Table 2. Quantified Energy-Specific Subsidies and Support By Type, FY 2013 (millions of 2013 dollars)

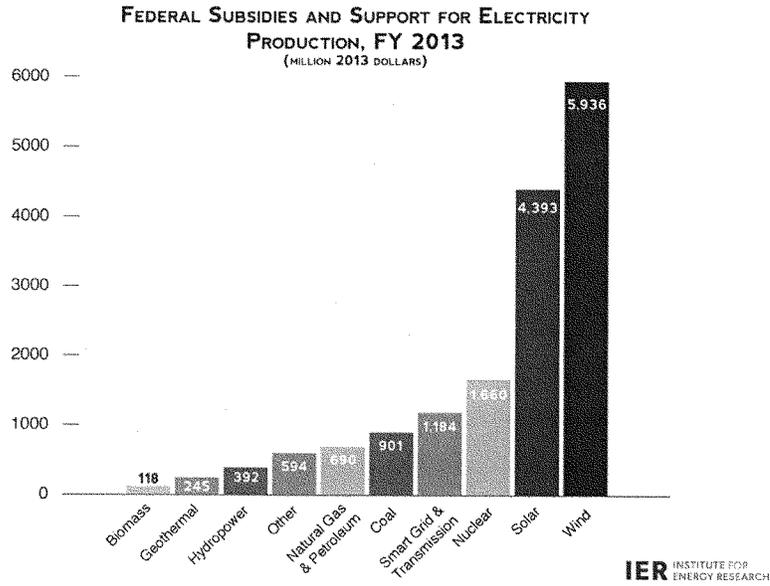
Beneficiary	Direct Expenditures	Tax Expenditures	Research and Development	DOE Loan Guarantee Program	Federal and RUS Electricity	Total	ARRA Related
<b>2013</b>							
Coal	74	769	202	-	30	1,075	129
Refined Coal	-	10	-	-	-	10	-
Natural Gas and Petroleum Liquids	62	2,250	34	-	-	2,346	4
Nuclear	37	1,109	406	-	109	1,660	29
<b>Renewables</b>	<b>8,363</b>	<b>5,453</b>	<b>1,051</b>	<b>-</b>	<b>176</b>	<b>15,043</b>	<b>8,603</b>
Biomass	332	46	251	-	-	629	369
Geothermal	312	31	2	-	-	345	312
Hydropower	197	17	10	-	171	395	216
Solar	2,969	2,076	284	-	-	5,328	3,137
Wind	4,274	1,614	49	-	-	5,936	4,334
Other	209	-	380	-	5	594	229
<b>Subtotal</b>							
<b>Renewables Electric</b>	<b>8,291</b>	<b>3,783</b>	<b>977</b>	<b>-</b>	<b>176</b>	<b>13,227</b>	<b>8,597</b>
Biofuels	72	1,670	74	-	-	1,816	6
<b>Electricity - Smart Grid and</b>							
<b>Transmission</b>	<b>8</b>	<b>211</b>	<b>831</b>	<b>-</b>	<b>134</b>	<b>1,184</b>	<b>780</b>
<b>Conservation</b>	<b>833</b>	<b>630</b>	<b>501</b>	<b>-</b>	<b>-</b>	<b>1,964</b>	<b>1,574</b>
<b>End Use</b>	<b>3,513</b>	<b>1,997</b>	<b>466</b>	<b>-</b>	<b>-</b>	<b>5,976</b>	<b>2,046</b>
LIHEAP	3,116	-	-	-	-	3,116	-
Other	397	1,997	466	-	-	2,860	2,046
<b>Total</b>	<b>12,891</b>	<b>12,428</b>	<b>3,491</b>	<b>-</b>	<b>449</b>	<b>29,258</b>	<b>13,166</b>

Source: EIA, Table ES2

As Table 2 indicates, in the realm of specific energy types, renewables—in particular, solar and wind—received the lion’s share of federal support. Specifically, of the \$29.3 billion in total federal financial intervention, \$15.0 billion went to renewables (with \$5.9 billion to wind and \$5.3 billion to solar), while only \$2.3 billion went to natural gas and petroleum liquids, \$1.7 billion went to nuclear, and \$1.1 billion went to coal.

In Figure 1 we present this same information in graphical form.

Figure 1.



Source: EIA, Table ES2

We can further refine EIA's analysis by looking just at electricity production subsidies.

Table 3. Electricity Production Subsidies and Support, FY 2013 (millions of 2013 dollars)

Beneficiary	Direct Expenditures	Tax Expenditures	Research and Development	DOE Loan Guarantee Program	Federal and RUS Electricity <sup>a</sup>	Total	Share of Total Subsidies and Support
Coal	61	642	167	-	30	901	6%
Natural Gas and Petroleum Liquids	18	662	10	-	-	690	4%
Nuclear	37	1,109	406	-	109	1,660	10%
<b>Renewables</b>	<b>7,408</b>	<b>3,373</b>	<b>722</b>	<b>-</b>	<b>176</b>	<b>11,678</b>	<b>72%</b>
Biomass	62	9	47	-	-	118	1%
Geothermal	221	22	2	-	-	245	2%
Hydropower	194	17	10	-	171	392	2%
Solar	2,448	1,712	234	-	-	4,393	27%
Wind	4,274	1,614	49	-	-	5,936	37%
Other	209	-	380	-	5	594	4%
<b>Subtotal Renewables Electric</b>	<b>7,408</b>	<b>3,373</b>	<b>722</b>	<b>-</b>	<b>176</b>	<b>11,678</b>	<b>72%</b>
Biofuels	-	-	-	-	-	-	-
Electricity - Smart Grid and Transmission	8	211	831	-	134	1,184	7%
<b>Total</b>	<b>7,532</b>	<b>5,996</b>	<b>2,136</b>	<b>-</b>	<b>449</b>	<b>16,112</b>	<b>100%</b>

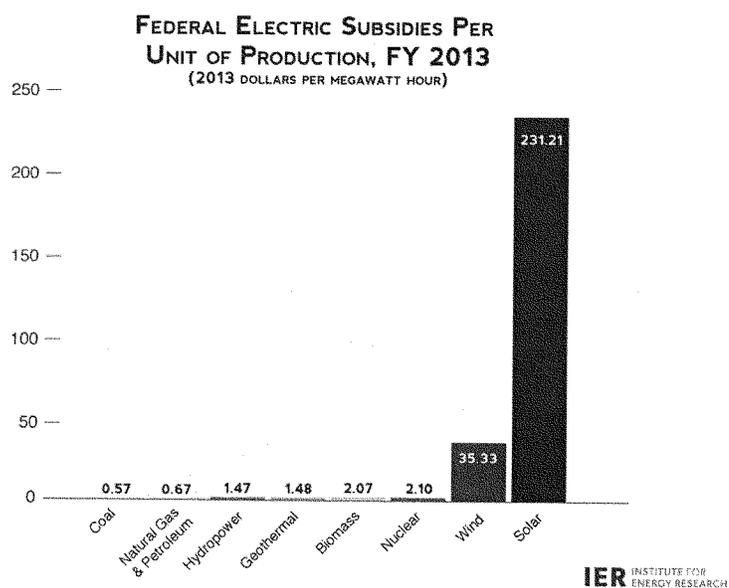
Source: EIA, Table ES4

As Table 3 shows, when we restrict our attention to electricity production, federal financial intervention totaled \$16.1 billion. Of that amount, 37 percent went to wind, 27 percent went to solar, 10 percent went to nuclear, 6 percent went to coal, and 4 percent went to natural gas and petroleum liquids.

Finally, although the EIA report does not directly provide these figures, we can use the information from the report to calculate federal support for electricity production *per unit of electricity produced*.<sup>12</sup> We present these findings in Figure 2.

<sup>12</sup> For more information on these calculations, and on EIA's rationale for not directly providing the data, see Mary Hutzler, "EIA Report: Subsidies Continue to Roll In For Wind and Solar," Institute for Energy Research blog post, March 18, 2015, available at: <http://instituteforenergyresearch.org/analysis/eia-subsidy-report-solar-subsidies-increase-389-percent/>.

Figure 2.



Source: IER calculations based on data from EIA (2015), “Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2013.”

As Figure 2 illustrates, once we adjust for the level of electricity output (in MWh), the disparity in federal support becomes even more lopsided, because wind and solar constitute such a small share of the total market. At \$231 per MWh, the support for solar is some 400 *times* the support for coal.

#### **Congressional Research Service (CRS) Assessment of Energy Tax Provisions, 2016-2020**

Although the data from the EIA report were illuminating, the report’s definition of “federal financial interventions and subsidies” included direct grants (which are not part of the tax code). To gain a tighter focus on energy tax provisions, we can rely on the latest Congressional

Research Service (CRS) report that specifically tallies them.<sup>13</sup> Table 4 summarizes the latest CRS findings.

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<sup>13</sup> The CRS data is included as an Appendix to the memo to committee members from the U.S. House of Representatives Committee on Energy and Commerce, March 27, 2017, available at: <http://docs.house.gov/meetings/IF/IF03/20170329/105798/HHRG-115-IF03-20170329-SD002.pdf>.

**Table 4. Federal Energy Tax Provisions and Their Budgetary Impact, 2016 Actual Cost and Projected 2016-2020 Cost**

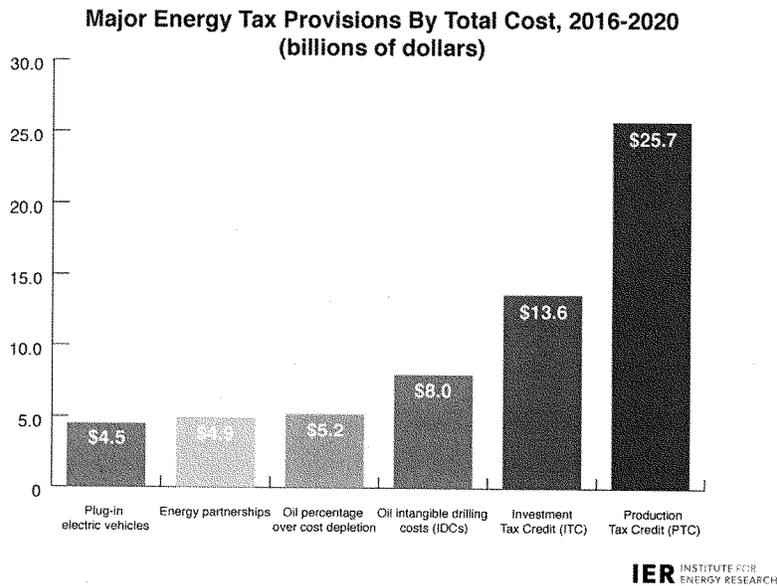
Tax Provision Item or Category	2016 Cost	2016-2020 Cost	% of 2016-2020 Cost
<b>FOSSIL FUEL TAX PROVISIONS</b>			
Expensing of percentage over cost depletion	\$0.9	\$5.2	6.3%
Expensing of intangible drilling costs (IDCs) and drymt expenditures for hard minerals	\$1.8	\$8.0	9.7%
Amortization of G&G expenditures for oil and gas exploration	\$0.1	\$0.6	0.7%
Coal production credits		\$0.2	0.2%
Credits for investing in clean coal facilities	\$0.2	\$1.0	1.2%
Amortization of air and pollution control facilities	\$0.5	\$4.2	5.1%
Exceptions for energy-related publicly traded partnerships	\$0.9	\$4.9	5.9%
Credit for alternative fuels and alternative fuels mixtures	\$0.8	\$0.9	1.1%
<b>RENEWABLES TAX PROVISIONS</b>			
Production Tax Credit (PTC)	\$3.4	\$25.7	31.1%
Investment Tax Credit (ITC)	\$2.6	\$13.6	16.4%
Section 1603 grants in lieu of tax credits	\$1.2	\$1.9	2.3%
Residential energy-efficient property credit	\$1.1	\$3.2	3.9%
Five-year cost recovery of certain energy property	\$0.3	\$2.0	2.4%
Credits for holders of clean renewable energy bonds		\$0.6	0.7%
Credit for biodiesel, renewable diesel, and second-generation (cellulosic) biofuels	\$2.2	\$2.6	3.1%
Advanced energy manufacturing tax credit	\$0.3	\$0.8	1.0%
<b>ENERGY EFFICIENCY TAX PROVISIONS</b>			
Credit for nonbusiness energy property	\$0.5	\$0.9	1.1%
Exclusion of energy conservation subsidies provided by public utilities		\$0.1	0.1%
Qualified energy conservation bonds		\$0.3	0.4%
Plug-in electric and other alternative fuel vehicles	\$0.3	\$4.5	5.4%
<b>OTHER ENERGY TAX PROVISIONS</b>			
Exclusion of interest on state and local government private activity bonds for energy production facilities		\$0.7	0.8%
Depreciation recovery periods for energy specific items	\$0.4	\$1.8	2.2%
Deferral of gains from the sale of electric transmission property	-\$0.2	-\$1.0	-1.2%
<b>TOTAL FOR ALL TAX PROVISIONS</b>	<b>\$17.3</b>	<b>\$82.7</b>	<b>100.0%</b>

Source: Adapted from Congressional Research Service,<sup>14</sup> Table 1.

As Table 4 indicates, of the measures analyzed by the CRS study, by far those with the largest cost (in the sense of tax expenditures) were the Production Tax Credit (PTC) at \$25.7 billion and the Investment Tax Credit (ITC) at \$13.6 billion, both targeted to renewable energy. The two costliest measures catering to oil and natural gas, namely the expensing of intangible drilling costs (IDCs) at \$8.0 billion and percentage vs. cost depletion at \$5.2 billion, constituted a much smaller budgetary impact.

In Figure 3 we chart the six costliest items in the CRS study.

**Figure 3.**



SOURCE: Adapted from Congressional Research Service, Table 1.

<sup>14</sup> See the appendix to the committee members memo at: <http://docs.house.gov/meetings/IF/IF03/20170329/105798/HHRG-115-IF03-20170329-SD002.pdf>.

### Federal Revenues By Energy Source

In previous sections we have provided statistics on the amount of federal tax support (in the sense of targeted deductions and credits) for participants in energy markets. To place these numbers in context, it may help to see the revenues actually *collected* by the federal government through various channels from the energy sector.

Unlike many other industries, those in the energy sector do not simply pay corporate income tax to the federal government, but often may make very large *non-tax* payments because the federal government legally owns resource-rich lands and waters. “When companies extract natural resources on federal lands and waters, they pay royalties, rents, bonuses, and other fees, much like they would to any landowner. This non-tax revenue is collected and reported by the Office of Natural Resources Revenue (ONRR).”<sup>15</sup>

In Table 5 we summarize the results posted at the Department of Interior’s website, concerning the 2015 payments of non-tax extraction revenues:

**Table 5.**

Commodity	Federal Extraction Revenue (2015)				
	Total	Securing Rights	Before Production	During Production	Other
Oil and Gas	\$6,159,534,275	\$682,107,972	\$237,555,805	\$ 5,281,260,458	-\$41,389,960
Coal	\$1,131,925,660	\$453,264,014	\$1,347,056	\$671,453,229	\$5,861,362
Geothermal	\$14,014,431	\$0	\$1,737,839	\$11,986,017	\$290,575
Offshore Wind	\$3,245,090	\$431,482	\$2,804,843	\$0	\$8,765

Source: Department of the Interior, <https://useiti.doi.gov/explore/#revenue>

As Table 5 illustrates, extraction revenues in 2015 from oil, natural gas, and coal dwarfed those of geothermal and wind; the totals are \$7.3 billion versus \$17 million. (We can’t present the data graphically, because the small values for geothermal and wind wouldn’t even show up in the chart.)

To reiterate, the data in Table 5 only show the *non-tax* revenues associated with extraction activities. We might also wonder about standard corporate income tax revenues associated with various energy sources. Unfortunately, such data do not seem to be available from government sources in this format.

<sup>15</sup> Quotation from: <https://useiti.doi.gov/explore/#revenue>.

However, we can get some idea of the respective contributions to federal tax receipts by looking at the latest IRS report on corporate tax returns broken down by “minor industry.” We present the relevant information in Table 6.

**Table 6. Select Data on Corporate Tax Returns by Energy-Related “Minor Industry,” Tax Year 2013 (money amounts in thousands of dollars)**

Minor industry	Number of returns		Income subject to tax	Total income tax after credits
	Total	With net income		
	(1)	(2)	(3)	(4)
<b>Total returns of active corporations</b>	<b>5,887,884</b>	<b>3,588,938</b>	<b>1,258,482,875</b>	<b>293,357,284</b>
Agriculture, forestry, fishing and hunting	136,483	81,468	3,454,823	1,000,288
Agricultural production	101,274	61,019	3,077,600	885,828
Forestry and logging	8,745	5,887	116,791	37,983
Support activities and fishing, hunting, and trapping	26,473	14,779	280,532	76,448
<b>Mining</b>	<b>38,603</b>	<b>23,070</b>	<b>25,887,838</b>	<b>4,886,248</b>
Oil and gas extraction	18,877	12,872	11,911,704	1,943,270
Coal mining	996	420	784,706	32,220
Support activities for mining	10,522	7,508	6,856,688	1,943,518
<b>Utilities</b>	<b>7,846</b>	<b>4,837</b>	<b>4,871,477</b>	<b>1,486,017</b>
Electric power generation, transmission, and distribution	1,427	370	1,804,178	286,671
Natural gas distribution	646	363	755,062	388,785
Water, sewage, and other systems	5,272	3,486	140,729	49,872
Combination gas and electric	501	417	2,381,608	703,689
<b>Manufacturing</b>	<b>242,786</b>	<b>155,980</b>	<b>472,446,983</b>	<b>86,191,133</b>
Petroleum and coal products manufacturing	1,039	739	123,426,735	6,908,479
Petroleum refineries (including integrated)	207	67	122,576,521	6,630,860
Asphalt paving, roofing, other petroleum and coal products	831	672	882,214	277,829
<b>Wholesale and retail trade</b>	<b>980,848</b>	<b>586,154</b>	<b>204,075,889</b>	<b>60,990,498</b>
Petroleum and petroleum products	7,083	4,455	2,468,771	407,787
Gasoline stations	45,376	28,538	1,388,024	453,186
<b>Transportation and warehousing</b>	<b>219,888</b>	<b>141,698</b>	<b>27,688,388</b>	<b>8,834,125</b>
Pipeline transportation	519	435	936,548	334,057
Other transportation and support activities	43,975	29,979	11,283,282	3,492,250

Source: Adapted from IRS, Statistics of Income (SOI), Returns of Active Corporations, Table 1, available at: <https://www.irs.gov/uac/soi-tax-stats-returns-of-active-corporations-table-1>

As Table 6 shows, in Tax Year 2013 oil and gas extraction alone contributed far more in total income tax (after credits) than the entire electric power generation, transmission, and distribution industry—\$1.9 billion versus \$300 million. And note that this latter figure is the *entire* listing for electric power, meaning it includes electricity generated by natural gas and coal, which account for the overwhelming bulk of total U.S. electric generation.

In summary, although we cannot find reports from official sources that expressly tabulate the total federal receipts broken down by energy type, it is safe to say that oil, natural gas, and coal generate vastly more in net payments to the U.S. government than renewable energy sources. These facts should be considered along with the earlier statistics concerning the disparity in tax expenditures (“subsidies”) by energy type.

### The History of the PTC and Its Impact on the Wind Sector

As discussed earlier, the Production Tax Credit (PTC) is the single most expensive (from the perspective of forfeited revenue) energy-targeted tax provision; the latest CRS report projected that the PTC would account for a tax expenditure of \$25.7 billion from 2016-2020. Because of its relative significance, and also because of its perverse effect of *negative* wholesale wind prices, we discuss the PTC in detail in this section.<sup>16</sup>

#### *Brief History of the PTC*

The PTC was first enacted in 1992 and, as of this writing, has since been extended ten times. The PTC provides owners of wind facilities a tax subsidy<sup>17</sup> tied to the general price level that currently works out to \$23 per megawatt-hour (MWh) of electricity generated for the facility's first 10 years of operation. To put the size of the subsidy in perspective, prices in wholesale electricity markets averaged \$30 per MWh in 2016.<sup>18</sup> Furthermore, because the PTC is a tax credit, its official current value of \$23 per MWh actually corresponds to a pre-tax wind price of  $\$23 / (0.65) = \$35$  per MWh, with the current corporate tax rate of 35 percent. (As we will see, this explains why wind producers are willing to accept negative wholesale prices even below minus \$20 per MWh.)

The PTC was extended in January 2013 and expired at the end of that year. In the extension bill, however, Congress expanded the qualification criteria to include facilities that had commenced construction by the end of 2013 instead of requiring that facilities be complete.<sup>19</sup> The change in language enabled the Internal Revenue Service (IRS) to expand eligibility to projects that had not initiated physical construction but had merely secured financing, including many facilities that began or will begin operation between January 1, 2014 and January 1, 2016.<sup>20</sup> (As a result, the government would have been providing PTC support through the year 2025.)

<sup>16</sup> This material draws heavily on the IER study, "The Case Against the Wind Production Tax Credit," November 2014, available at: <http://instituteforenergyresearch.org/wp-content/uploads/2014/11/The-Case-Against-the-PTC-Nov-2014.pdf>.

<sup>17</sup> Some analysts make a distinction between a tax credit (which reduces tax liability) and an explicit payment issued by the federal government, reserving the term "subsidy" for the latter. However, with the wind PTC the distinction is not crisp in practice, because the tax credit is so large that many wind operations cannot take full advantage of it. That is why they bring in Wall Street firms to effectively auction off the tax credit to outside financiers, and it also explains why so many renewable groups clamor to make the PTC a *refundable* tax credit.

<sup>18</sup> Electricity wholesale prices for 2016 available at: <https://www.eia.gov/electricity/wholesale/#history>

<sup>19</sup> Nick Juliano, IRS guidance clarifying PTC eligibility seen as boon for developers, E&E News Greenwire, August 11, 2014, <http://www.eenews.net/greenwire/stories/1060004314/>.

<sup>20</sup> Although the PTC has expired, developers can qualify for the tax credit without starting physical construction on a wind facility. The IRS released a guidance document stating that a project would be eligible for the PTC if it had either: (1) started "physical work of a significant nature" or (2) satisfied "the Safe Harbor with respect to a facility," as long as the developer made "continuous progress towards completion" once the construction phase had begun.

As of this writing, the latest legislation<sup>21</sup> concerning the PTC is the Consolidated Appropriations Act, 2016 (H.R. 2029, Sec. 301), passed in December 2015. This legislation enacted a gradual “phase out” of the PTC. Specifically, for wind facilities commencing construction in 2017, the PTC is reduced by 20 percent; for those starting in 2018, the PTC is reduced by 40 percent; and for those starting in 2019, the PTC amount is reduced by 60 percent.

*A Perversion of the Market: The PTC and Negative Wholesale Wind Prices*

The case of the PTC is an excellent illustration of how generous tax code “support” for a particular energy type—in this case, wind—can lead to results that clearly make no economic sense. Specifically, at times of low demand wind operators can end up driving wholesale electricity prices into very negative territory—even below minus \$20 per MWh. Because the PTC is only applicable for actual production, the owners of a wind facility can reduce their overall tax liability by the PTC credit even if they are “losing money” on the wind generation itself.

Although it might make sense for certain producers to offer negative prices for brief periods to the grid in order to avoid a disruptive shutdown of generation, this does *not* make sense for wind operators. “Unlike nuclear and fossil-fueled generation[,] wind generation is physically flexible, as it can be shut down or turned back on reasonably quickly by altering the pitch of the turbine blades or by disconnecting or reconnecting the turbines to the electric grid.”<sup>22</sup> Clearly, the unusual practice of prolonged selling at *negative* prices is driven by the tax code, not the underlying economic realities.

Furthermore, with the expansion of wind capacity over time, this phenomenon of negative wholesale electricity prices became more pronounced, as we illustrate in Figure 4.

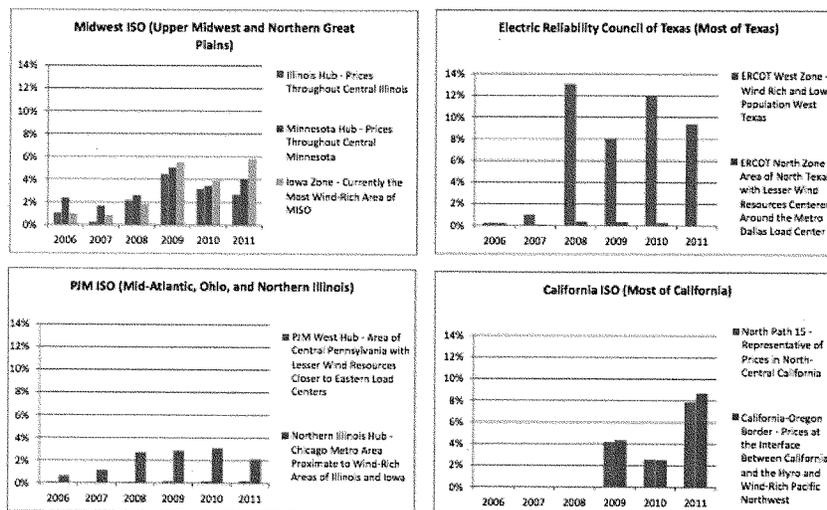
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Many facilities that are placed in service before January 1, 2016 will satisfy the continuous progress standards. <http://www.irs.gov/pub/irs-drop/n-14-46.pdf>

<sup>21</sup> The current status of the PTC is taken from: <https://energy.gov/savings/renewable-electricity-production-tax-credit-ptc>. (Accessed March 25, 2017.)

<sup>22</sup> Frank Huntowski, Aaron Patterson, and Michael Schnitzer, “Negative Electricity Prices and the Production Tax Credit,” The NorthBridge Group, September 10, 2012, available at: <http://acore.org/wp-content/uploads/2012/09/Negative-Electricity-Prices-and-the-PTC-Sept-2012.pdf>, p. 7.

**Figure 4. Percentage of Hours with Negative Real-Time Electric Energy Prices in Select Markets, 2006 – 2011**



NOTE: California ISO data not available prior to 2009.

Source: Huntowski et al. 2012,<sup>23</sup> Figure 6.

As Figure 4 indicates, the phenomenon of negative wholesale electricity prices became much more common in certain markets especially after 2007. It is natural to attribute this increase in large part to the growing proliferation of wind capacity.

*Wind Advocates Connect PTC With Wind Capacity Growth: That's Not a Good Thing*

We should note that even the *supporters* of wind energy fully agreed that the PTC has been and continues to be vital to the expansion of wind capacity. For example, the current page devoted to the PTC at the website of the American Wind Energy Association (AWEA) says:

Thanks to this policy certainty, 18 gigawatts of wind power capacity are now under construction or in advanced development. With the PTC phasedown, wind

<sup>23</sup> Frank Huntowski, Aaron Patterson, and Michael Schnitzer, "Negative Electricity Prices and the Production Tax Credit."

energy can [continue] growing to supply 10 percent of U.S. electricity by 2020 and support tens of thousands additional well-paying jobs.

With the help of the PTC and ITC, U.S. wind farms now provide enough power for 24 million American homes and attract billions in private investment to the U.S. economy each year...

The PTC and ITC has driven more wind development...<sup>24</sup>

The AWEA analysis is undoubtedly correct that a generous tax credit—so generous that it justifies paying customers to take the product—will encourage the expansion of a particular sector. But by itself, this is evidence that the outcome is a *distortion*, because of the artificial advantage given to wind. Or, from the other side, we could say that the tax code (with the PTC) has placed an artificial *disadvantage* on electrical generation sources that do *not* qualify for the credit.

Although artificial tax advantages can make outcomes “rational” at the individual level, from the perspective of the overall economy they are inefficient. It would distort producer and consumer behavior less if the target amount of tax revenues were raised on a more uniform basis, with resources flowing into various energy types based on their actual profitability and reliability.

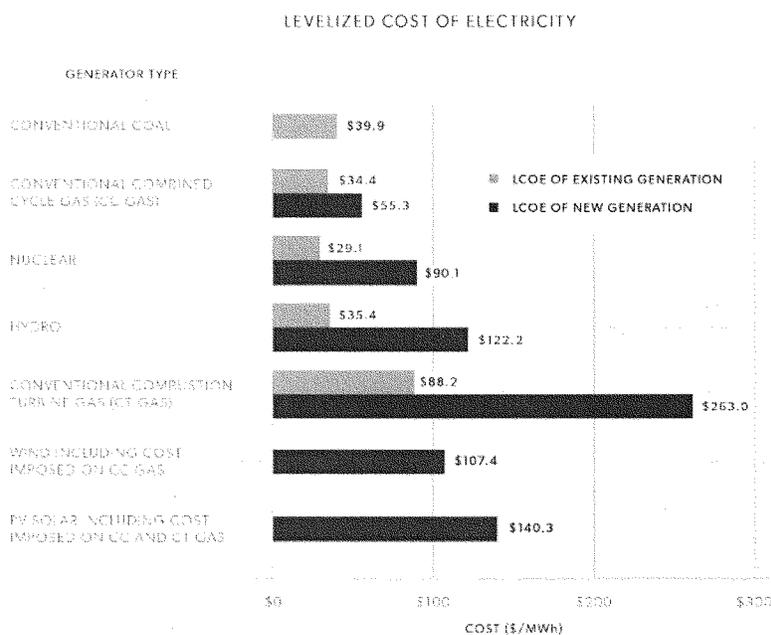
#### **Artificial Federal Support for Certain Energy Sources Leads to Inefficiency**

To understand the inefficiencies resulting from an artificial advantage given to wind and solar, consider the levelized cost of electricity generation from various sources.

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<sup>24</sup> American Wind Energy Association (AWEA), “Production Tax Credit,” available at: <http://www.awea.org/production-tax-credit>. Accessed March 25, 2017.

Figure 5.



SOURCE: Stacy and Taylor (2016),<sup>25</sup> p. 5.

There are two important takeaways from Figure 5. First, note that with these estimates, electricity from new wind and solar generation is more expensive than electricity from new gas or nuclear generation. Second and perhaps more important, the relevant comparison on the margin is the levelized cost of *existing* generation, if the issue is whether policymakers want to actively reduce generation from some sources (such as coal) and replace it with growth in other sources (such as wind and solar). On this margin, the increases in costs of generation are even more pronounced.

<sup>25</sup> Thomas F. Stacy and George S. Taylor, "The Levelized Cost of Electricity From Existing Generation Resources," Institute for Energy Research (IER), July 2016, available at: [http://instituteeforenergyresearch.org/wp-content/uploads/2016/07/IER\\_LCOE\\_2016-2.pdf](http://instituteeforenergyresearch.org/wp-content/uploads/2016/07/IER_LCOE_2016-2.pdf). (Note that the IER study's figures do not directly correspond to those reported by EIA, because the study authors believe certain realistic adjustments are needed to produce more accurate estimates. See the study for more details.)

### **The Economic Impact of Certain Tax Provisions Related to the Oil Sector**

Although the PTC is explicitly designed to foster growth in electricity generation from renewables, there are other aspects of the current tax code that provide benefits to the oil sector. For example, the provision for percentage depletion (rather than cost depletion, which is more analogous to standard depreciation of business expenses) gives an artificial advantage to oil production under certain conditions.<sup>26</sup> However, we note that the percentage depletion is *not* available to integrated oil companies and is limited to output below 1,000 barrels per day;<sup>27</sup> this is not a “tax break for Big Oil” as many critics allege.

Two other provisions—namely, the Domestic Manufacturer’s Section 199 deduction and the allowance of Last-In, First-Out (LIFO) inventory accounting—are beneficial to oil and natural gas companies. However, it is incorrect to classify these as “tax breaks for oil and gas companies” as critics often allege. These are standard tax code provisions available to all sectors. (In fact, the Section 199 deduction has been made artificially *lower* for oil and gas companies than for others, with the former only able to claim a 6 percent deduction versus the standard 9 percent deduction for other manufacturers.<sup>28</sup>)

### **Two Challenges to the General Principle of Allowing the Price System to Guide Energy Markets**

Before closing, we should address two common challenges made to the general presumption of letting free consumer and producer decisions guide energy markets, without outside “steering” from the political process. These challenges are the “infant industry” argument and the concern over anthropogenic climate change.

The infant industry argument claims that a new domestic industry needs a helping hand from policymakers (such as in the form of protective tariffs or other preferential tax treatment) to get up and running. In general this is a dubious proposition. Private investors are just as capable of forecasting the long-term benefits of today’s investments, and indeed have more incentive to get their forecasts right because their own money is on the line.

Regarding federal support for renewables, the infant industry argument is particularly weak since these arguments have been made for decades. These are not infant industries, these are grown adults. If they can’t compete (except in niche markets) on a level playing field with other sources of electrical generation, this reflects economic realities, not birthing pains.

<sup>26</sup> See Timothy Fitzgerald and John Horowitz, “Economics of the Tax Treatment of Depletable Costs,” November 11, 2014, Working Paper.

<sup>27</sup> There are other limitations on percentage depletion; see: <http://www.ipaa.org/wp-content/uploads/downloads/2012/01/2009-04-PercentageDepletion.pdf>.

<sup>28</sup> See: <http://www.thetaxadviser.com/issues/2010/may/sec199.html>.

A completely separate argument claims that the “negative externality” from carbon dioxide emissions is not reflected in market prices, and therefore the tax code (so it is alleged) implicitly gives a “subsidy” to carbon-intensive energy sources. In this view, providing federal support for alternative energy sources is merely mitigating this long-standing bias.

The present document concerns tax policy, not climate science. However, we refer to IER’s work on the dubious use of the “social cost of carbon” as a policymaking tool.<sup>29</sup> It is important for policymakers to realize that *even if* we stipulate the physical science of climate change as codified in, for example, the Intergovernmental Panel on Climate Change (IPCC) reports, that *it does not follow* that the U.S. government should therefore adopt measures to penalize carbon dioxide emissions. The “social cost of carbon” is *not* an objective fact of the world, analogous to the charge on an electron or the mass of the moon. Rather, it is an arbitrary concept dependent on subjective parameters such as the discount rate applied to estimates of damages that will not occur for centuries. Once we consider these and other complications—such as the interaction of penalties on carbon dioxide emissions with existing inefficiencies in the tax code—the case for promoting alternative energy sources becomes much weaker.

### Conclusion

Although they differ on the emphasis to be given to certain priorities, economists generally agree that if we were to design a tax code from scratch, the desired revenue would be raised by applying the tax to as broad a base as possible, with as low a rate as possible. Adding in artificial privileges to particular groups is a self-defeating and inefficient process, because it distorts consumer and producer behavior and invites “rent seeking” from groups trying to shield themselves from unfavorable tax treatment. When policymakers try to steer markets through the tax code, it makes Americans poorer because resources are no longer being channeled into their most important uses. This includes the resources being spent in complying with the (unnecessarily complex) tax code itself.

In the context of energy, there are several provisions of the tax code that give advantages to particular producers or consumers. A recent Congressional Research Service (CRS) study estimated that from 2016-2020, the total cost of these energy tax provisions would be \$82.7 billion. Of the provisions analyzed, the two most expensive were the Production Tax Credit (PTC) and the Investment Tax Credit (ITC), both tailored to renewable energy.

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<sup>29</sup> For example, see Robert P. Murphy’s testimony on “The ‘Social Cost of Carbon’: Some Surprising Facts,” before the Senate Committee on Environment and Public Works, July 18, 2013, available at: <http://www.instituteforenergyresearch.org/wp-content/uploads/2013/07/2013.07.18-Murphy-EPW-Testimony-on-Social-Cost-of-Carbon-FINAL.pdf>.

It is clear that these tax provisions distort energy markets. For example, the generous PTC has made it commonplace for wholesale electricity prices to be negative, because wind producers can benefit financially once the tax credit is taken into account. Yet it is inefficient to artificially encourage wind (and solar) in this manner, because their correctly-calculated levelized cost of generation—particularly when we look at *existing* facilities which some wish to retire through policy—is so much higher than that of coal and natural gas.

A popular slogan says that the U.S. should embrace an “all of the above” approach to energy sources. This is a sensible stance, if understood to mean that policymakers do not try to *foster* those energy sources that are currently providing only a small share of total output. Both theory and history have shown that private property and market prices lead to superior outcomes than top-down planning. This result holds for energy markets just as it does for restaurants.

Mr. UPTON. Thank you.  
Mr. Hartman? Got to keep talking.

#### STATEMENT OF DEVIN C. HARTMAN

Mr. HARTMAN. Good morning, Mr. Chairman and members of the subcommittee. Thank you for inviting me to have this conversation with you today.

When competitive energy markets thrive so do consumers, innovation, and the environment. Well-functioning markets require transactions to account for all costs and benefits. Markets alone do not fully capture the external cost of pollution nor the benefits of all knowledge gains. Government interventions have sometimes helped to address these market shortcomings, but often result in costly unintended consequences that leave society worse off. This underscores the importance of limiting government's role to efficiently correcting market shortcomings with an underlying objective to enhance market performance.

Energy policy discussions frequently stray from focus on market performance. Often they romanticize particular technologies associated with certain desirable qualities. From this, industrial policy narratives have emerged where government explicitly picks winners. This central planning bias has notably manifested itself in procurement mandates and subsidies including some tax preferences. Industrial policies undermine market performance. They inherently result in political disputes over the right technologies leading to politically vulnerable and unstable policies. This has contributed to the proliferation of false narratives and half-truths that complicate our ability to have a civil, factual energy policy discussion.

Tax preferences can be effective tools for industrial policy, but they seldom correct for market failures efficiently. Economic research is not kind to targeted tax incentives. They are expensive and inefficient. Clean-energy tax preferences reduce emissions modestly at high cost. Tax incentives for nascent technologies may create limited knowledge gains, but they deter R&D in technologies that don't receive preferences. At the same time, tax preferences and other industrial policies increasingly distort energy markets. For example, production tax credits artificially depress electricity prices, which undermines efficient investment and grid management, while investment tax credits skew investment towards capital-intensive projects.

Tax preferences also create entrenched interest that deepen cycles of subsidization. Look no further than reauthorization of tax preferences for mature technologies or excluded technologies seeking subsidies to compensate for their competitors' preferences. The future performance of competitive energy markets depends on unwinding existing industrial policy, not layering on additional counter-distorting subsidies.

With that said, some energy tax incentives improve cost recovery, a tenet of pro-growth tax structure, but only apply to select technologies. For example, some provisions allow full expensing, which is preferable to depreciation because it lowers the cost of capital. However, uneven tax treatment can distort competitive relation-

ships. Moving toward uniform expensing treatment would mitigate these distortions and ensure vibrant competition.

While the best course of action is to eliminate tax preferences, Congress may instead pursue a more modest direction. Improvements to existing preferences should follow objective criteria, such as basing eligibility on technology-neutral performance criteria. Department of Energy programs should also follow objective economic criteria. DOE direct investments in applied energy research more than double those in basic research, whereas the greatest spillover benefits of knowledge creation occur in basic research.

All technologies should compete on their merits. High costs are a natural barrier to entry that does not justify intervention. In contrast, regulatory rules that preclude technologies from participating or receiving fair market compensation present artificial barriers to entry. Modernizing these rules would improve market performance while leveling the competitive playing field.

Americans deserve an energy policy where markets pick winners, not government. We need an energy policy vision that enhances market performance and uses taxpayers' dollars wisely. Congress has an opportunity to take major strides in pursuing a politically durable and economically rewarding energy-policy framework that includes the following: phase out distortionary tax preferences; enable broad-based cost recovery in the tax code; align public research expenditures with knowledge spillover benefits; reduce unnecessary regulatory burdens; and encourage electricity market reforms that enhance competition.

This framework will generate economic dynamism, improve environmental quality, reward innovative companies, lower customer bills, and place the United States on a more fiscally responsible pathway. Thank you for your time.

[The prepared statement of Mr. Hartman follows:]



1050 17<sup>th</sup> Street, N.W.  
Suite 1150  
Washington, DC 20036  
202.525.5717

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**Testimony of Devin C. Hartman**

**Electricity Policy Manager and Senior Fellow**

**R Street Institute**

**Washington, D.C.**

**To the Subcommittee on Energy**

**U.S. House Committee on Energy and Commerce**

**Hearing on "Federal Energy Related Tax Policy and its Effects on Markets, Prices and Consumers"**

**March 29, 2017**

**Beyond Preferences: Embracing a Competitive Energy Vision**

Good morning, Chairman Upton, Ranking Member Rush, and members of the subcommittee. Thank you for the opportunity to testify before you today on the increasingly salient topic of energy tax policy. My name is Devin Hartman, and I am electricity policy manager and a senior fellow with the R Street Institute, a pragmatic free-market think tank. I have experienced and examined the effects of tax policy on energy markets at the state and federal level. My research specialties include the effects of government intervention on the electricity industry. What I offer today are my personal views.

A discussion on energy tax policy should begin with the full context of energy policy. Energy policy primarily concerns the oil, natural gas and electricity industries. Domestic energy policy has limited

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ability to affect oil market outcomes, where global economic forces remain the key drivers.<sup>1</sup> On the other hand, domestic policy is a principle determinant of market structure and outcomes in the natural gas and electricity industries. Deregulation of natural gas began in the 1980s, with mature markets emerging in the 1990s. About half the states initiated electricity restructuring (i.e., price deregulation) in the 1990s, although fewer executed full implementation that lasted through the 2000s.

Competitive reforms in the natural gas industry were a resounding success.<sup>2</sup> The more recent transition to electricity competition and consumer choice experienced substantial challenges, but the benefits are becoming increasingly clear. From 1997 through 2014, electricity prices in regulated monopoly states increased 60 percent, compared with 41 percent in restructured states.<sup>3</sup>

Research and experience have demonstrated immense advantages of competitive energy markets that incorporate the full costs and benefits of transactions among their participants. "Pure private" markets do not fully capture some benefits, such as research and development spillovers, or some costs, such as pollution externalities. Government interventions, including tax preferences, have sometimes helped to address these market shortcomings, but often result in costly unintended consequences that leave society worse-off. This underscores the importance of limiting government's role to correcting market shortcomings *efficiently*, with an underlying objective to enhance market performance.

Energy policy discussions frequently stray from a focus on market performance. Often they romanticize particular power-generation technologies that are associated with certain qualities like reliability or low emissions. From this, industrial-policy narratives have emerged where government explicitly picks winners (and occasionally losers) via direct support for particular technologies or industries. This central-planning bias has notably manifested itself in federal and state procurement mandates and subsidies, including some tax preferences.

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<sup>1</sup> Oil is a fungible, global commodity. In contrast, natural gas is not nearly as transportable. The differences in transportation costs mean more variation in natural-gas pricing between countries and even within regions of the United States.

<sup>2</sup> For example, see Paul Joskow, "Natural Gas: From Shortages to Abundance in the United States," *American Economic Review*, Vol. 103, No. 3, pp. 338-43, May 2013.

<https://www.aeaweb.org/articles?id=10.1257/aer.103.3.338>

<sup>3</sup> Philip R. O'Conner and Eric M. O'Connell-Diaz, "Evolution of the Revolution: The Sustained Success of Retail Electricity Competition," COMPETE Coalition, July 2015.

[https://www.hks.harvard.edu/hepg/Papers/2015/Massey\\_Evolution%20of%20Revolution.pdf](https://www.hks.harvard.edu/hepg/Papers/2015/Massey_Evolution%20of%20Revolution.pdf)

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Technology policy narratives are typically detached from firm economic principles and sound scientific evidence. Industrial policies undermine market performance. They inherently result in greater economic costs and political disputes over the "right" technologies, leading to politically vulnerable and unstable policies.

Congress has an opportunity to take major strides in pursuing a politically durable and economically rewarding policy framework. That means truly leveling the competitive playing field and enhancing market performance to the benefit of the economy and environment. That recipe largely boils down to encouraging wholesale-electricity-market reforms that enhance competition, reduce unnecessary regulatory burdens, tighten and improve public energy expenditures and phase out distortionary tax preferences. This will improve environmental quality, reward innovative companies and lower customer bills while expanding their choices. It also places the United States on a more fiscally responsible pathway.

#### **Rationales for energy tax preferences and public expenditures**

Market failures present an economic rationale for policy intervention to improve market performance. Interventions not aimed at correcting market failures lack economic merit altogether. The presence of a market failure merely presents an *opportunity* for policy intervention to improve market functionality. Even benevolent interventions often unintentionally undermine market performance. In many cases, interventions use policy instruments—including tax preferences and direct expenditures—that are poorly suited to correct for a particular type of market failure.

#### *Energy security*

Energy security is a nebulous concept linked to several different claims of market failure. I will focus my attention on the continuity of physical energy supply and the economic ramifications of price spikes. The first consideration is whether fuel imports put U.S. military readiness and economic activity at risk of fuel shortage. This is only minimally applicable to the electricity and natural gas industries, which rely overwhelmingly on domestic fuel sources and Canadian imports, but may be of concern in the oil

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industry. In 2015, the United States imported 24 percent of the oil it used, the lowest proportion since 1970, but still a substantial sum.<sup>4</sup>

Economic evidence from oil markets suggests that concerns over physical oil supply shortages are overblown. The global oil market is highly integrated, with fungible flows.<sup>5</sup> Even when one supply line is disrupted, supplies remain available from alternate sources or countries. During the 1973 Arab Oil Embargo, which cut the United States and allies off from some Arab supplies, oil was readily available on the international market. Government intervention—specifically, price ceilings—caused the oil shortages and gas-station lines, not any physical inability to obtain oil on the international market.

The second interpretation of energy security suggests supply disruptions in the global oil market leave the United States exposed to the adverse macroeconomic effects of price shocks. This means U.S. oil dependence, regardless of import share or volume, creates economic vulnerability.<sup>6</sup> The economic costs of oil dependency may present a market failure through the exercise of market power by the Organization of Petroleum Exporting Countries (OPEC) cartel, which elevates prices above competitive levels.<sup>7</sup> Price shocks in oil markets, however, are on the wane. Global oil demand projections have substantially softened over the last decade and vast exploitable oil reserves—particularly in the United States and Canada—have forced down international oil prices and served to mute OPEC's influence. Today, the U.S. fracking industry responds swiftly to any attempts by OPEC to raise global prices. Furthermore, many large oil consumers enter long-term oil price agreements to hedge volatility risk.

This presents a weak case for subsidizing domestic oil development. There is no plausible case to subsidize natural gas and primary fuels for electricity generation on grounds of energy security. Altogether, this does not warrant further discussion on tax incentives or direct expenditures to correct for energy-security concerns.

#### *Principal-agent problems and information deficiencies*

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<sup>4</sup> Energy Information Administration, "How much oil consumed by the United States comes from foreign countries?" March 8, 2016. <http://www.eia.gov/tools/faqs/faq.cfm?id=32&t=6>

<sup>5</sup> Joel Darmstadter, "Energy Independence: Fantasies, Facts, Options," Resources for the Future, November 2006. <http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-IB%2006-02.pdf>

<sup>6</sup> Ibid.

<sup>7</sup> David L. Green, "Measuring energy security: Can the United States achieve oil independence?" *Energy Policy*, Vol. 38 (4), April 2010. <http://www.sciencedirect.com/science/article/pii/S0301421509000755>

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Energy consumers often run into the principal-agent problem, where one party (the agent) makes decisions on behalf of another party (the principal). This creates a potential market failure when the incentives of the agent differ from those of the principal, causing the agent to fail to account for the principal's interests. This commonly arises when property owners incur the costs of making energy-efficiency investments, but tenants receive the benefits in energy savings (if they are responsible for covering utility bills). This may cause property owners to underinvest in energy efficiency, unless they can recover the benefits of the investment some other way (e.g., rent premium). Conversely, tenants may overconsume energy if the property owner is responsible for paying utilities.

Energy consumers also have information deficiencies that adversely affect their decisions. For example, property owners sometimes do not understand the full value proposition of an energy-efficiency investment. Some studies suggest this contributes to consumers having an implicitly high rate of return that leads to underinvestment in energy efficiency. This deters consumers from making such investments, given their high upfront cost and long payback period.

Tax instruments are poor tools to address principal-agent problems and information asymmetries. They do not address the cause of the underlying market failures (misaligned incentives and incomplete information), just the symptoms. A policy instrument better equipped to address these causes would be information disclosures. Tax incentives are also blunt instruments, poorly suited for the case-specific nature of principal-agent and information problems. Many recipients of tax incentives would have undertaken the investment without the incentives, which raises the costs to achieve the policy objective.<sup>8</sup> Consumers' increased abilities to self-educate, especially in the digital age, often goes overlooked, as well.

### *Pollution externality*

An externality results when two parties in a transaction fail to consider the benefits or costs imposed on a third party. This results in an overproduction/consumption of the product associated with a costly externality and underproduction/consumption of a product with a beneficial one. Air pollution is a

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<sup>8</sup> Gilbert E. Metcalf, "Tax Policies for Low-Carbon Technologies," *National Bureau of Economic Research*, June 2009. <https://core.ac.uk/download/pdf/6716337.pdf>

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prevalent example of a negative externality in the energy field, where the parties buying and selling the power do not account for the effects on human health and the environment. Pricing negative externalities (e.g., pollution tax) is the most economically efficient policy, but policymakers often find the approach politically impractical.<sup>9</sup> The focus then shifts to whether alternative policy interventions would provide more benefit than harm.

The portrayal of subsidies for clean energy as nearly equivalent to pricing pollution externalities is very problematic, as the underlying market failure is underpricing of pollution, not overpricing of clean energy.<sup>10</sup> In theory, subsidies, as a mirror image of taxes, can provide incentives to reduce emissions. In practice, they often promote economically inefficient and environmentally unsound actions.<sup>11</sup> Targeted tax preferences for clean energy are a form of industrial policy with potential environmental co-benefits, which is very different from an economical approach to environmental policy.

### *Knowledge spillovers*

The creation of knowledge by one entity can benefit others. Individual companies cannot capture these spillover benefits for themselves (i.e., a positive externality). This results in the private sector having insufficient incentive to develop and deploy new technologies.<sup>12</sup> The main channels of knowledge creation are research and development (R&D) and learning-by-doing. Learning-by-doing occurs when early production of a technology creates new information that reduces the cost of future production.

Energy R&D has large spillover benefits, whereas those for learning-by-doing are typically quite small.<sup>13</sup> At the same time, waiting to adopt technologies with rapidly declining costs also has benefits (i.e.,

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<sup>9</sup> Severin Borenstein, "The Private and Public Economics of Renewable Electricity Generation," Energy Institute at Haas, December 2011. <https://ei.haas.berkeley.edu/research/papers/WP221.pdf>

<sup>10</sup> Ibid.

<sup>11</sup> Robert N. Stavins, "Experience with Market-Based Environmental Policy Instruments," Resources for the Future, November 2001. <http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-01-58.pdf>

<sup>12</sup> Adam B. Jaffe, et al., "A tale of two market failures: Technology and environmental policy," *Ecological Economics*, Vol. 54 (2-3), August 2005. <http://www.sciencedirect.com/science/article/pii/S0921800905000303>

<sup>13</sup> For example, see Carolyn Fischer, et al., "Environmental and Technology Policy Options in the Electricity Sector: Interactions and Outcomes," Resources for the Future, December 2013.

<http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-13-20.pdf>

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procuring the technology at lower cost in the future). In some energy-technology scenarios, the benefits of learning-by-waiting may outweigh the benefits of learning-by-doing.<sup>14</sup>

Research suggests that overcoming knowledge spillover effects presents a clear case for public R&D support, but remains unclear on intervention to support large-scale deployment.<sup>15</sup> Policy options to address R&D spillovers include tax preferences, direct payments and the creation of government programs (i.e., Department of Energy) that provide research and other industry support.

### Effects of energy tax preferences and public expenditures

The effects of energy tax preferences and public expenditures depends on their magnitude and form. The Congressional Research Service estimated that, between 2015 and 2019, the cost of energy tax incentives was \$21.5 billion for fossil fuels, \$46.5 billion for renewables and \$3.1 billion for energy efficiency.<sup>16</sup> The production tax credit (PTC), investment tax credit (ITC) and Section 1603 grants comprise the vast majority of energy tax incentive costs for renewables. Capital cost recovery dominates fossil-fuel tax provisions.<sup>17</sup>

### *Distinguishing targeted preferences from cost recovery*

Generally, expanding the ability to recover legitimate business costs boosts economic growth. Most fundamental tax-reform proposals move the code toward more rapid depreciation of such expenses, or the ability to write them off fully, in pursuit of a tax climate that does not penalize a business for investments in research or capital. From a growth and neutrality perspective, the tax code would ideally allow all businesses, in all industries, to recover their costs and face taxation only on their net income.

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<sup>14</sup> William W. Hogan, "Clean Energy Technologies: Learning by Doing and Learning by Waiting," seminar, September 2014. [https://www.hks.harvard.edu/m-rcbg/cepr/Hogan\\_LBD\\_Overview\\_092914%20\(2\).pdf](https://www.hks.harvard.edu/m-rcbg/cepr/Hogan_LBD_Overview_092914%20(2).pdf)

<sup>15</sup> National Academies of Sciences, Engineering, and Medicine, *The Power of Change: Innovation for Development and Deployment of Increasingly Clean Electric Power Technologies*, The National Academies Press, September 2016. <https://www.nap.edu/catalog/21712/the-power-of-change-innovation-for-development-and-deployment-of>

<sup>16</sup> Molly F. Sherlock and Jeffrey M. Stupak, "Energy Tax Policy: Issues in the 114<sup>th</sup> Congress," Congressional Research Service, June 2016. <https://fas.org/sgp/crs/misc/R43206.pdf>

<sup>17</sup> Fossil-fuel tax preferences fall into three categories: 1) subsidizing extraction of high-cost fossil fuels; 2) encouraging investment in cleaner fossil fuels or non-petroleum options; and 3) enhancing capital-cost recovery.

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In contrast, many technology-specific tax credits and payments (such as refundable credits or outright subsidies) act as targeted production and investment subsidies, instead of allowing for legitimate cost recovery. For example, fossil and renewable tax credits are industry-specific production preferences intended to reduce the cost of operation through the tax code. Generally, targeted tax credits are inefficient at promoting economic growth.<sup>18</sup> Moreover, such tax preferences are generally poorly suited to correct pollution externalities, principal-agent problems and information deficiencies.

Some energy-related tax preferences have beneficial cost recovery structures, especially those that permit immediate expensing. Expensing is preferable to depreciation, the default treatment of capital investments, which raises the cost of capital by dragging out the time period over which a business can reduce the tax hit associated with a given investment. Among common tax-reform options, full expensing results in some of the largest economic growth gains per dollar of federal revenue foregone.<sup>19</sup> The tax code's treatment of energy production includes many disparate, industry-specific provisions that create a complicated playing field. Uneven application can distort competitive relationships between industries and sets of technologies. Moving toward uniform expensing treatment across energy industries and technologies would mitigate these distortions and ensure vibrant competition, absent political manipulation.

*Cost-effectiveness*

Current tax preferences are not cost-effective policies to reduce pollution. Modeling studies have found, at best, a small effect of subsidies on reducing greenhouse-gas emissions, while in some cases increasing emissions.<sup>20</sup> The emissions that renewables displace are highly sensitive to regional and subregional electric fuel-mix patterns. For example, wind generation in areas with high nuclear and hydroelectric generation will not displace emissions as effectively as in areas with high fossil-fuel generation. Uniform tax preferences fail to account for this, whereas an emissions tax would efficiently build pollution costs into subregional power-dispatch decisions.

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<sup>18</sup> Joint Economic Committee, "The Inefficiency of Targeted Tax Policies," April 1997. <https://www.jec.senate.gov/public/cache/files/fe2eafaa-f355-462f-b515-15ad4a8f5e74/the-inefficiency-of-targeted-tax-policies-april-1997.pdf>

<sup>19</sup> Tax Foundation, "Options for Reforming America's Tax Code," 2016. [https://files.taxfoundation.org/legacy/docs/TF\\_Options\\_for\\_Reforming\\_Americas\\_Tax\\_Code.pdf#page=84](https://files.taxfoundation.org/legacy/docs/TF_Options_for_Reforming_Americas_Tax_Code.pdf#page=84)

<sup>20</sup> Brian C. Murray, et al., "How Effective are U.S. Renewable Energy Subsidies in Cutting Greenhouse Gases?" *American Economic Review*, Vol. 104 (5), May 2014. <https://www.aeaweb.org/articles?id=10.1257/aer.104.5.569>

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Existing policies, regulatory environments and market conditions affect the incremental costs and benefits of tax preferences. State renewable portfolio standards (RPS), which mandate a minimum percentage of electricity generation from renewable sources, heavily drive renewables development. Renewable tax credits have peripheral effects on renewables investment by "lubricating the markets," but RPS policies remain the principle driver of renewable energy development.<sup>21</sup> This diminishes the incremental benefits of avoided pollution from renewable tax preferences.

This interplay with RPS policies contributes to how the costs of tax preferences for pollution reduction far outweigh the benefits. A National Academy of Sciences review concluded that production and investment tax credits for renewable electricity reduced carbon dioxide (CO<sub>2</sub>) emissions at an average cost of \$250 per ton.<sup>22</sup> This far exceeds most estimates of the benefits of avoided CO<sub>2</sub> emissions.<sup>23</sup> Furthermore, the displacement of emissions by renewable energy will generally decrease going forward as the electric fuel mix becomes cleaner, which will drive avoided pollution costs upward.

Picking winners through the tax code is also problematic in promoting energy innovation. Tax preferences steer the private sector to invest in government-preferred technologies, rather than pursue the most productive use of capital to drive innovation. It also deters R&D in new technologies, as prospective developers may find it harder to compete with incumbents receiving preferential treatment.<sup>24</sup> Rather, changing the code to allow expensing of R&D costs would provide a relatively efficient and technology-neutral method to advance innovation.

Proponents of the "infant industry argument" suggest that public policy, including tax treatment, should be partial to new technologies to provide protection through their developmental stages. Preferential treatment raises a host of problems, including policymakers' inability to know when to end industry protection (or how much to provide) and the creation of "rent-maintenance" behavior, where the infant

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<sup>21</sup> Todd Bessemer and Francis X. Shields, "Resource Investment in the Golden Age of Energy Finance: Financial Investment Drivers and Deterrents in the Competitive Electricity Markets of the U.S. and Canada," ISO/RTO Council, May 2015. [http://www.isorto.org/Documents/Report/201505\\_IRCResourceInvestmentReport.pdf](http://www.isorto.org/Documents/Report/201505_IRCResourceInvestmentReport.pdf)

<sup>22</sup> National Research Council, *Effects of U.S. Tax Policy on Greenhouse Gas Emissions*, National Academies Press, 2013. [www.nap.edu/catalog/18299](http://www.nap.edu/catalog/18299)

<sup>23</sup> For example, the Environmental Protection Agency recently estimated the damage of one ton of CO<sub>2</sub> to be between \$40 and \$60.

<sup>24</sup> Joint Committee on Taxation, "Present Law and Analysis of Energy-Related Tax Expenditures," June 9, 2016. <https://www.jct.gov/publications.html?func=startdown&id=4915>

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industry seeks continued partial treatment after maturity.<sup>25</sup> History suggests that direct subsidies and tax exemptions for energy innovation continue well after targeted technologies have matured.<sup>26</sup> Furthermore, the inconsistent application of temporary tax preferences has caused inefficient investment behavior, such as the boom-bust cycles of wind development in response to periodic PTC reauthorizations. Subsidies for energy innovation are most effective when they are predictable, contain an outcome or performance structure and include sunset provisions.<sup>27</sup>

Direct government support for energy innovation has a spotty record. Expanding government programs create opportunities for government failure, where the intervention creates inefficiencies that can outweigh the harm caused by the market failure. For example, government failure has been more persistent and costly than market failure with respect to alternative-energy development.<sup>28</sup> Government failure appears particularly pronounced in late-stage technology development involving complex project management. The Government Accountability Office and others have criticized the Department of Energy (DOE) extensively for poor management of large demonstration projects.<sup>29</sup>

Energy R&D funded by DOE has had mixed results, with a relatively high rate of technology transfer to the private sector.<sup>30</sup> Assessing the benefits of basic R&D is very challenging, but it presents the greatest opportunity to maximize public investment in energy R&D. In contrast, DOE's funding of technology demonstration projects in the late development stage has not been cost-effective.<sup>31</sup> Federal agencies do not have an advantage in lowering production costs.<sup>32</sup> DOE's performance indicates room for improvement in basic R&D and calls into question the role of the federal government in managing demonstration projects.

<sup>25</sup> Devin Hartman "Wholesale Electricity Markets in the Technological Age," R Street Institute, August 2016.

<http://www.rstreet.org/wp-content/uploads/2016/08/67.pdf>

<sup>26</sup> National Academies of Sciences, Engineering, and Medicine, 2016.

<sup>27</sup> National Academies of Sciences, Engineering, and Medicine, 2016.

<sup>28</sup> Peter Z. Grossman, "U.S. Energy Policy and the Presumption of Market Failure," *Scholarship and Professional Work – Business*, 2009. [http://digitalcommons.butler.edu/cgi/viewcontent.cgi?article=1027&context=cob\\_papers](http://digitalcommons.butler.edu/cgi/viewcontent.cgi?article=1027&context=cob_papers)

<sup>29</sup> Government Accountability Office, "Department of Energy: Consistent Application of Requirements Needed to Improve Project Management," May 2007. [www.gao.gov/products/GAO-07-518](http://www.gao.gov/products/GAO-07-518)

<sup>30</sup> Congressional Budget Office (CBO), "Federal Support for the Development, Production and Use of Fuels and Energy Technologies," November 2015. [https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/50980-Energy\\_Support.pdf](https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/50980-Energy_Support.pdf)

<sup>31</sup> Terry M. Dinan, "Testimony: Federal Financial Support for Fuels and Energy Technologies," U.S. House Committee on Science, Space, and Technology Subcommittee on Energy," March 13, 2013.

<http://www.cbo.gov/sites/default/files/cbofiles/attachments/03-12-EnergyTechnologies.pdf>

<sup>32</sup> CBO, 2015.

Economic studies indicate that the effectiveness of energy-efficiency policies is highly sensitive to the degree that customers undervalue energy efficiency.<sup>33</sup> The economic literature lacks consensus on the degree of undervaluation.<sup>34</sup> This underscores the difficulty in determining the efficient level of incentives for energy-efficiency investments and amplifies the likelihood that government failure outweighs market failure in contriving energy-efficiency tax preferences. Even the task of administratively identifying technologies and arranging programs cannot cover all energy-savings practices and will not meritoriously identify future technologies.<sup>35</sup>

#### *Market distortions*

Energy market distortions from tax preferences often go overlooked, but these unintended effects have growing consequences. In competitive electricity markets, investors' expectations of future market prices drive investment decisions. Policies that distort price formation in electricity markets cause inefficient operation of the electricity system and inefficient capital-investment decisions.

The PTC compensates recipients based on electrical output. Wind generators benefit the most from the PTC. Since wind generators have physical operating costs near zero, the PTC pushes their effective operating costs negative. This, along with renewable energy credits, results in some wind generators offering into wholesale electricity markets at negative levels.<sup>36</sup> In areas with high electric-transmission congestion, this can cause negative electricity prices. This artificially suppresses revenues to all generators, reducing their profit margins and creating grid operation challenges. This may also contribute to premature power plant closures or higher prices in electricity-capacity procurement.<sup>37</sup>

The ITC and Section 1603 grants, which provide one-time cash grants in lieu of tax credits, also distort capital investment decisions. The ITC and Section 1603 grants skew investment toward capital-intensive

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<sup>33</sup> Fischer, et al., 2013.

<sup>34</sup> Fischer, et al., 2013.

<sup>35</sup> Joint Committee on Taxation, 2016.

<sup>36</sup> Phillip Brown, "U.S. Renewable Electricity: How Does Wind Generation Impact Competitive Power Markets?" Congressional Research Service, November 2012. <https://fas.org/sgp/crs/misc/R42818.pdf>

<sup>37</sup> The downward pressure put on "real-time" energy-market revenues will put upward pressure on capacity-market revenues.

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projects. This may encourage selection of lower-value projects with poor performance profiles (e.g., do not produce reliably).<sup>38</sup>

In states clinging to the regulated electric monopoly model, state public utilities commissions decide whether to approve investments proposed by utilities. In contrast to competitive markets, where investors incur and manage risk, the regulated model socializes investment risk on ratepayers. This means investment risk associated with tax preferences is borne by ratepayers, sometimes resulting in different investment decisions and poor risk management.

One example is the effect of the advanced nuclear power production credit. To qualify, a new nuclear facility must enter service by the end of 2020. The multibillion dollar value of the credit factored into state regulators' decisions to expand two nuclear facilities in Georgia and South Carolina. Construction delays have caused investors and credit rating agencies to doubt the projects' completion in time to qualify for the credit, with resulting costs likely shouldered, in part, by ratepayers. By comparison, an independent power producer would face the full investment risk of failing to qualify for the credit.

*Distinguishing market enhancements from industrial policy*

Economists overwhelmingly prefer technology-neutral policy instruments to correct for market failures like R&D spillovers and pollution. However, federal and state energy policies to date have tended to favor certain technologies or industries explicitly. This has resulted in an energy policy discourse dominated by what industries or technologies to advance, rather than how best to improve market performance.

Industrial policies have primarily emerged with a green tint, anchored by the proliferation of renewable federal tax preferences and state RPS policies. They have created entrenched interests and facilitated a culture seeking ongoing subsidization. Look no further than current tax preferences for renewable technologies that have long since matured.

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<sup>38</sup> Harrison Fell, Joshua Linn and Clayton Munnings, "Designing Renewable Electricity Policies to Reduce Emissions," Resources for the Future, December 2012. <http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-12-54.pdf>

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The legacy of green industrial policy consists of unnecessary costs, modest pollution reductions and deepened political tensions. This led to calls for counter-industrial policy that seeks preferential treatment for technologies excluded from the initial green industrial policy agenda. Examples of this range from requests for bailouts for unprofitable nuclear plants to favorable tax treatments for cleaner fossil fuels.

Continued efforts to pick winners through the tax code contributed to the current patchwork of tax preferences working at cross-purposes. Tax preferences for environmentally damaging activities conflict with others for clean energy. Contradictions even exist between clean-energy provisions. Renewable energy preferences artificially depress power prices, leading to overconsumption and disincentives for energy efficiency.<sup>39</sup>

Meanwhile, fiscal circumstances have deteriorated. This places greater scrutiny on all budgetary considerations, including energy tax preferences and direct expenditures. However modest in the larger budget picture, energy policy discourse cannot lose sight of our escalating national debt.

Economic conservatives are wise to express skepticism of extensive tax preferences and direct expenditures for favored technologies. However, sometimes those opposed to poor government interventions misdirect their criticism of interventions, rebuffing the legitimate market failures such interventions aim to address. This raises inaccurate skepticism of the "disease" used to justify the "medicine" they oppose. The medicine of green industrial policy is harsher than the disease, but the best remedies to energy market failures are consistent with limited government principles. Competitive markets, with targeted market-based interventions to address externalities, provide the formula for a wealthier economy and healthier environment.

Fortunately, the model for energy success has become clearer. Competitive natural gas and electricity markets have created large cost savings, reduced emissions and spurred innovation over the past decade. Open electricity markets create pathways to voluntary, low-cost emissions reductions. A surge in consumer interest, both at the corporate and household levels, in buying clean energy has contributed to increases in "organic" clean energy growth in states that permit electric customer choice.

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<sup>39</sup> Borenstein, 2011.

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It has also led to demands for electricity consumers to choose their electric provider in states that restrict it. Markets also create a competitive platform that rewards innovators and facilitates transitions to breakthrough technologies. Congress can improve these markets by leveling the tax field, reducing red tape, avoiding industrial policies, encouraging market-enhancing reforms at the Federal Energy Regulatory Commission (FERC) and supporting efficient complimentary R&D policies.

**Takeaways and recommendations**

Well-functioning competitive energy markets are the best choice for innovation, consumers and the environment. The United States cannot affordably mandate and subsidize its way to a clean energy future. Industrial policies increasingly subvert competitive energy markets and contribute to a mounting public debt burden. It is time to reawaken the markets.

Industries and technologies should excel based on their merits, not political popularity. Congress can steer U.S. energy policy back toward market principles, where competitive forces pick winners, not government. Several areas to begin include:

1. *Phasing-out distortionary energy tax preferences.* The emergence of a level tax field begins with eliminating investment and production tax credits and payments. These encourage increased production from government-preferred technologies and industries and do not expand legitimate cost recovery.
2. *Subjecting all energy tax provisions to objective criteria.* While the best course of action is to eliminate all tax preferences in favor of a cleaner code that allows broad-based cost recovery, Congress may instead pursue a course of more modest changes. Improvements to existing preferences should follow principled economic criteria, such as:
  - a. Phase-out technology-specific preferences based on levels of deployment (e.g., a production level that achieves economies of scale).
  - b. Avoid "picking winners" arbitrarily by making tax preferences technology-neutral (e.g., based on performance criteria).
3. *Equalizing beneficial tax structures.* Tax structures that permit greater cost recovery enhance economic growth. For example, full expensing of energy R&D costs would permit companies to invest in the most productive innovations, not government-preferred technologies. Differential

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treatment in cost recovery for one industry or set of technologies can create competitive imbalances. Policy reforms may rectify this by broadening applications that enable cost recovery uniformly across industries and technologies.

4. *Aligning public R&D spending with spillover benefits.* Policy reform should emphasize basic R&D while scaling-back late stage (e.g., demonstration) project support. Additional good governance considerations include improved DOE program performance metrics, constant program reevaluation to determine when to phase-out government investment, stronger linkages to private sector needs and interests and scrutinizing expenditures in context of a constrained fiscal environment.
5. *Expanding the focus of "leveling the competitive playing field" to regulatory reforms.* Opportunities to cut red tape abound, from hydroelectric and advanced nuclear licensing to modernizing the Clean Air Act. Leveling the playing field also means removing artificial barriers to entry for unconventional technologies in wholesale electricity markets under FERC jurisdiction. Improving rules that affect electricity market price formation will also help stimulate efficient investments.

I will be happy to answer any questions.

Mr. UPTON. Thank you.  
Mr. Clemmer?

#### STATEMENT OF STEVE CLEMMER

Mr. CLEMMER. Good morning. On behalf of the Union of Concerned Scientists and our 500,000 supporters, I would like to thank Chairman Upton, Representative McNerney, and the other distinguished members of the subcommittee for the opportunity to testify today. In contrast to a couple of the previous speakers, my comments today are going to focus on how the Federal tax credits for renewable energy have been an effective and affordable policy.

As Representative McNerney said, tax credits have been a key driver for the recent growth in the wind and solar industries spurring innovation and creating new jobs, income, and tax revenues for State and local economies. They have also been very effective in driving down the cost of wind and solar power, making renewable energy more affordable for consumers. Tax credits are needed to provide more parity in the tax code with fossil fuels and nuclear power.

As we have heard, these industries have received enormous tax subsidies and other tax benefits over the past hundred years. And I would take issue with some of the presentation of these subsidies either on an annual basis or even a few years. Because some of the tax preferences for other technologies are permanent, you really need to look at this over a long period of time which paints a very different picture than what we have heard.

Federal tax credits also represent a way to value the environmental and other public benefits of renewable energy that are not currently priced in energy markets. Tax credits have also helped the U.S. become a global leader in manufacturing and deploying renewable-energy technologies with excellent potential for export. Federal tax credits combined with State renewable standards have been the key driver for the recent growth in wind and solar.

As Representative McNerney said, the U.S. wind capacity has more than doubled since 2010 and has accounted for more than a third of all generating capacities since 2007. It has also just recently surpassed U.S. hydro capacity. In addition, a record amount of solar went in last year as we heard nearly doubling the previous year's record and making solar the largest source of new capacity for the first time.

The rapid growth in these technologies have provided significant benefits to State and local economies. The wind industry has invested more than \$143 billion in the U.S. economy over the past decade and almost all of this has gone into rural areas where these wind farms are located. They have also added nearly 15,000 jobs in 2016, reaching a total of over a hundred thousand jobs in all 50 States. The amount of employment has doubled since 2013 in the wind industry.

The growth of domestic manufacturing of wind turbines is also a major success story. More than 500 manufacturing facilities located in 43 States produced 50 to 85 percent of the major wind turbine components installed in the U.S. Just back in 2007 we were only producing about 20 percent. Wind power is also providing a significant source of income for rural communities. About 70 per-

cent of wind projects installed in 2015 are located in low-income counties that fall below U.S. median household income levels. Wind also provided \$222 million in lease payments to landowners in 2015.

The solar industry is also a major source of new jobs. Total industry employment doubled since 2012 and 51,000 jobs were added in 2016. In total, there are more than 9,000 businesses located in every State that is involved in the solar industry. A recent DOE report found that more Americans worked in solar and wind power generation in 2016 than in either nuclear, coal, natural gas, or hydroelectric generation. As we have heard, the cost of wind and solar have also fallen by about two-thirds since 2009.

The tax credits are also a benefit for consumers. Recent DOE analyses have shown that the environmental and public health benefits of increasing renewable energy are 2 to 3 times greater than the cost of the Federal tax credits. The studies that DOE did also showed that renewables could reduce wholesale electricity prices and natural gas prices, saving consumers about \$13 to \$49 per megawatt hour of renewable generation.

In terms of the policies going forward, Federal tax credits and R&D funding have been important complements to State policies, as I have discussed. But until we can transition to national policies that recognize the public benefits of renewables and other low-carbon sources of energy in energy prices, we recommend extending the tax credits by at least 5 more years to maintain the sustained, orderly growth of the industry.

A long-term tax credit extension for renewables could also be part of a well-designed technology-neutral tax credit, and tax credits should also be expanded to encourage investments in energy-storage technologies to help accelerate deployment and cost reductions. Thanks again for the opportunity to testify. I would be happy to answer any questions.

[The prepared statement of Mr. Clemmer follows:]

**Federal Renewable Energy Tax Credits:  
Creating American Jobs and Investment in State and Local Economies**

**Testimony of Steve Clemmer  
Director of Energy Research and Analysis  
Climate & Energy Program  
Union of Concerned Scientists**

**Before the  
Subcommittee on Energy  
Committee on Energy and Commerce  
U.S. House of Representatives  
Hearing on “Federal Energy Related Tax Policy and its Effects on Markets, Prices and  
Consumers”  
March 29, 2017**

**SUMMARY**

- Federal tax credits for renewable energy have been an effective and affordable policy, delivering significant economic benefits across the United States.
- Federal tax credits have improved the playing field for renewables to compete with fossil fuels and nuclear power, which have benefitted from large federal subsidies for decades and market prices that do not reflect many external costs of burning fossil fuels
- Subsidies for different energy technologies should be compared over a long period of time since many incentives for conventional energy sources are part of the permanent tax code
- AWEA analysis shows that wind energy only received 3% of all federal energy incentives between 1947 and 2015, compared to 65% for fossil fuels and 21% for nuclear power.
- Tax credits have been a key driver for the recent growth in the U.S. wind and solar industries, creating new jobs, income, and tax revenues for local communities
- Tax credits have helped drive down the cost of wind and solar power, which has helped stabilize electricity prices and make renewable energy more affordable for consumers.
- DOE analyses show that the benefits of increasing renewable energy use are about 2-3 times higher than the costs of the PTC.
- Until the U.S. can transition to national policies that provide more stable, long-term support for low carbon energy, Congress should extend the federal tax credits by at least five more years to maintain industry growth and provide more parity and predictability in the tax code.
- A long-term tax credit extension for renewable energy could also be part of a well-designed low-carbon technology neutral tax credit. Tax credits should be expanded to encourage investments in energy storage to help accelerate deployment and cost reductions.

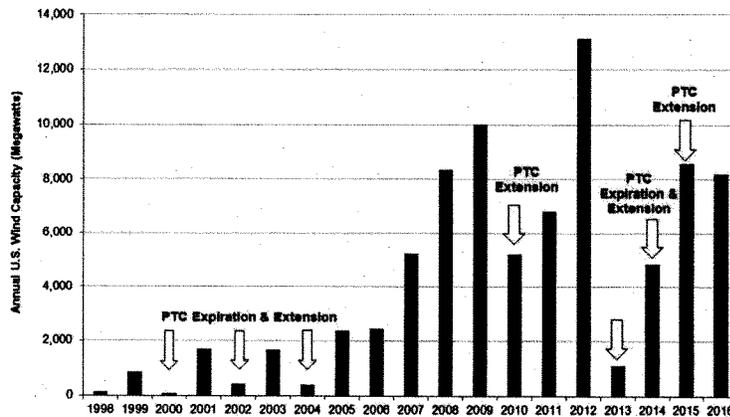
On behalf of the Union of Concerned Scientists (UCS), I would like to thank Chairman Upton, Ranking Member Rush, and the other distinguished members of the Subcommittee for the opportunity to testify today. My name is Steve Clemmer, Director of Energy Research and Analysis for UCS' Climate and Energy Program. UCS is the nation's leading science-based nonprofit organization with more than 500,000 supporters. We put rigorous, independent science to work to solve our planet's most pressing problems. Our Climate and Energy Program focuses on developing a sustainable and affordable energy system—one that does not degrade natural systems or public health. UCS has been a leading advocate of increasing renewable energy use at the state and national levels for many years. We also care deeply about jobs and communities affected by a transition to a clean energy economy, and we support strong targeted policies for economic diversification, workforce development, and R&D to help create more opportunities for impacted communities.

My comments today will focus on how federal tax credits for renewable energy have been an effective and affordable policy, delivering significant economic benefits across the United States. I will describe how they have been a key driver for the recent growth in the U.S. wind and solar industries, spurring innovation and creating new jobs, income, and tax revenues for local communities. I will also show how they have helped drive down the cost of wind and solar power, which in turn has helped stabilize electricity prices and make renewable energy more affordable for consumers. Finally, I will highlight the need to extend the tax credits, provide more parity in the tax code with fossil fuels, and transition to policies that provide more stable, long-term support for renewable energy.

### A Brief History of Federal Renewable Energy Tax Credits

The federal Production Tax Credit (PTC) is tied to the amount of electricity generated from eligible renewable energy facilities, which encourages efficiency and innovation to maximize production. Originally enacted as part of the Energy Policy Act of 1992, Congress has extended the PTC seven times and has allowed it to expire on six occasions. This "on-again/off-again" status resulted in a boom-bust cycle of development. In the years following expiration, installations dropped between 76 and 93 percent, with corresponding job losses (see Figure 1). After many years of this policy uncertainty, Congress passed a five-year extension and phase-down of the PTC for wind projects commencing construction through 2019, as part of the Consolidated Appropriations Act of 2016. The credit was extended for other eligible renewable energy technologies commencing construction through 2016.

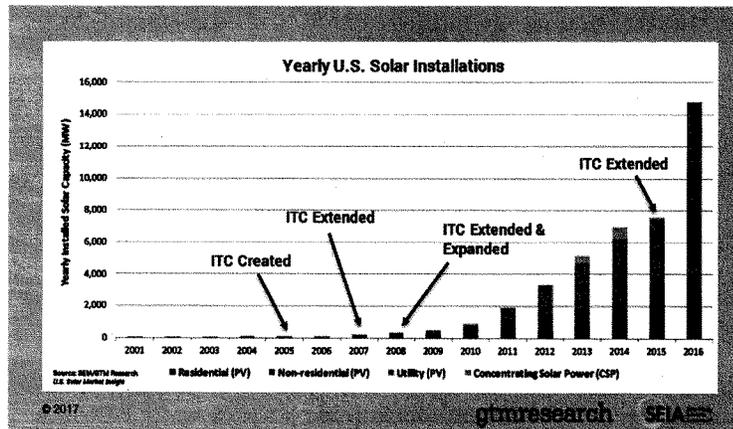
**Figure 1. Impact of Production Tax Credit Expiration and Extension on Annual U.S. Wind Capacity Installations**



Sources: Wisner and Bolinger 2016, AWEA 2017a.

The federal Investment Tax Credit (ITC) allows residential, commercial, and utility investors to claim 30 percent of the up-front capital investments for solar and other qualified renewable energy technologies against their tax liability. Created as part of the Energy Policy Act of 2005, the ITC has been extended and expanded several times. In contrast to the PTC, however, the ITC has been a relatively stable policy, avoiding most of the boom-and-bust cycle that wind energy projects have faced (Figure 2). In 2008, the ITC was extended for eight years for commercial, utility, and residential projects. In December 2015, Congress passed a five-year extension and phase-down of the ITC as part of the Consolidated Appropriations Act of 2016. Like the PTC, the ITC was also modified so that projects are now eligible for the credit based on when they commence construction rather than when they begin to produce power. Together with decreasing prices for solar energy technologies, the certainty these longer-term extensions provided investors has resulted in a rapid increase in U.S. solar installations over the past decade.

**Figure 2. Impact of Investment Tax Credit Expiration and Extension on Annual U.S. Solar Capacity Installations**



Source: SEIA 2017b.

Federal tax credits for renewable energy are needed to provide more parity in the tax code with fossil fuels and nuclear power, industries that have received huge tax benefits and other subsidies over the past 100 years. The Majority Memorandum cites EIA studies that only quantify subsidies for a single year in recent history to claim that renewable energy sources have received far greater subsidies than fossil energy sources. They also provide cost estimates from a 2017 Joint Committee on Taxation report that only include a limited number of years (2016 to 2020) for certain tax provisions. A more accurate comparison would be to look at subsidies for different energy technologies over a longer period of time since many incentives for conventional energy sources have been part of the permanent tax code for decades. For example, using a compilation of data from several government and third party sources, a 2016 analysis by AWEA found that wind energy only received 3 percent of all federal energy incentives between 1947 and 2015, compared to 65 percent for fossil fuels and 21 percent for nuclear power (Wanner 2016). The estimated \$27 billion in subsidies for wind pales in comparison to the \$619 billion in subsidies for fossil fuels and \$197 billion for nuclear over this time frame. The data used by AWEA includes all federal spending for research and development, tax incentives, direct deployment incentives and other interventions. Based on 2015 government projections of the costs of the PTC through 2025, AWEA estimates that wind energy will still only account for around 6 percent of total federal incentives.

A 2011 UCS analysis of nuclear power subsidies shows that existing nuclear plants have already received subsidies that have cost taxpayers more than the market price of power they helped generate, and they continue to receive ongoing subsidies ranging from 1-6 cents per kilowatt-hour (kWh) (Koplow 2011). For comparison, the PTC for wind is currently worth

about 2.3 c/kWh for 10 years. New nuclear plants are also eligible for a PTC for a limited period of time, which was included in the Energy Policy Act of 2005.

As I discuss in more detail below, federal tax credits also represent a way to value the environmental and other important public benefits of renewable energy that are currently not priced in energy markets or captured by other policies. This improves the playing field for renewable energy to compete with the more mature fossil fuel and nuclear industries.

Federal tax credits for renewable energy have enjoyed strong bi-partisan support since they were adopted in 1992. A primary reason for the bipartisan nature of the tax credits is that both Republicans and Democrats alike recognize the jobs and other economic benefits that renewable energy development brings to their state and local economies. The tax credits have also helped make the U.S. a global leader in manufacturing and deploying renewable energy.

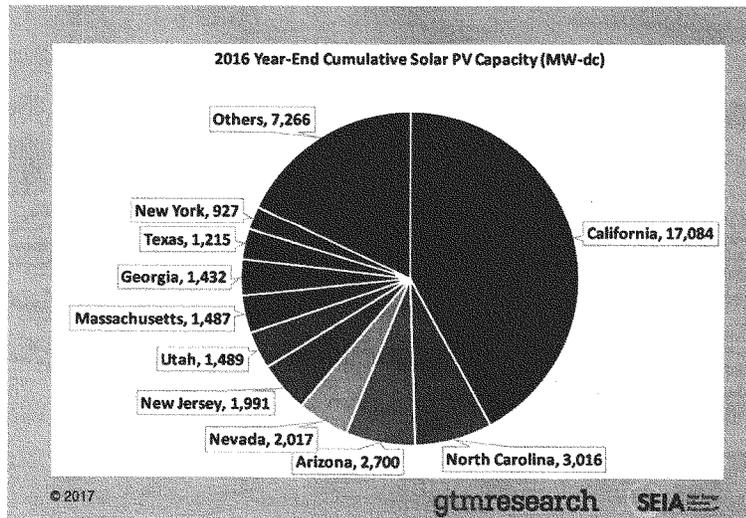
#### **Federal Tax Credits are a Key Driver of Renewable Energy Development**

Federal tax credits, combined with state renewable standards, have been a key driver for the recent growth in the U.S. wind and solar industries. U.S. wind capacity has more than doubled since 2010 and has accounted for nearly one-third of all new electric generating capacity since 2007. The wind industry installed more than 8,200 MW of wind capacity in 2016, reaching a total installed capacity of more than 82,000 MW (AWEA 2017a). The American Wind Energy Association (AWEA) estimates that 88 percent of the wind power added in 2016 was built in states that voted for President Trump, while 86 percent of total U.S. installed wind capacity in 2015 and 65 percent of wind manufacturing facilities are located in Republican districts (AWEA 2016a and 2017a). Texas leads the national with 20,300 MW of installed wind capacity, followed by Iowa, Oklahoma, California, Kansas, Illinois, Minnesota, Oregon,

Washington, and Colorado. An additional 18,300 MW are under construction or in advanced development, according to AWEA.

A record 14,800 MW of solar electric capacity was installed in the U.S. in 2016, nearly doubling the previous year's record and making solar the largest source of new capacity for the first time (SEIA 2017a). Over 42,000 MW of total solar capacity is now installed in the U.S., producing enough electricity to power 8.3 million homes. The industry has experienced a compound annual growth rate of nearly 60 percent since 2010. California leads the nation with more 17,000 MW of installed solar capacity, followed by North Carolina, Arizona, Nevada, New Jersey, Utah, Massachusetts, Georgia, Texas and New York (Figure 3). The Solar Energy Industries Association (SEIA) projects total installed U.S. solar PV capacity to nearly triple over the next five years.

**Figure 3. Leading States for Installed Solar PV Capacity**



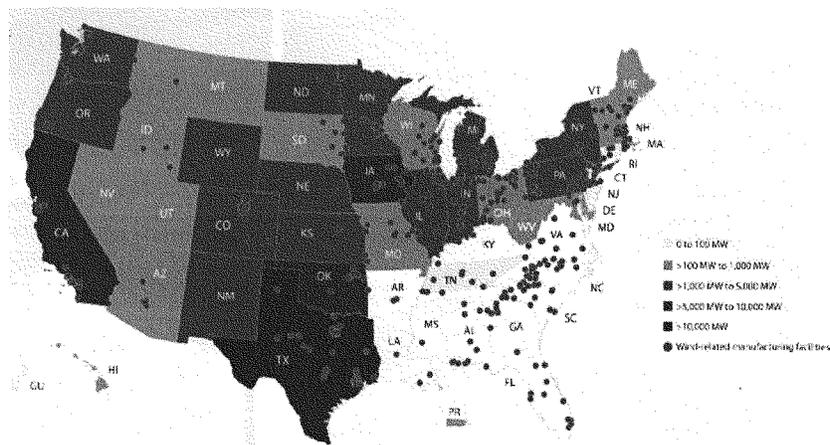
**Federal Tax Credits Create American Jobs and Other Economic Benefits**

The rapid growth the wind and solar industries have experienced in the United States over the past several years due to federal tax credits and state policies has resulted in significant economic benefits for state and local economies. Over the past decade, the wind industry has invested more than \$143 billion in the U.S. economy, with much of this investment flowing to rural areas where the wind projects are located (AWEA 2017). In 2016, the U.S. wind industry added nearly 15,000 new jobs, reaching a total of 102,500 direct and indirect full-time equivalent jobs in construction, manufacturing, operations, planning, and development in all 50 states, up from 50,500 jobs in 2013 (AWEA 2017b). Texas, the national leader in installed wind capacity, also has the most wind-related jobs with more than 22,000. Other top states for wind jobs include Iowa, Oklahoma, Colorado, and Kansas, each having between 5,000 and 9,000 employees, and California, Illinois, North Dakota, Minnesota and Nebraska, with each employing more than 3,000 people. Navigant Consulting projects total wind-related jobs will reach 248,000 by 2020, including 146,000 direct and indirect jobs and 102,000 induced jobs (AWEA 2017b).

Domestic manufacturing of wind turbine components has also grown significantly over the past decade. More than 500 manufacturing facilities located in 43 states produced 50-85 percent of the major wind turbine components installed in the United States in 2015, up from 20 percent in 2007 (Figure 4) (Wiser and Bolinger 2016, AWEA 2017b). Ohio is the leading state for wind manufacturing with more than 60 facilities, followed by Texas (40), Illinois (35), North Carolina (27), and Michigan, Pennsylvania and Wisconsin (26 each). Colorado, Iowa, Texas, and California are also national leaders manufacturing major wind turbine components. While

the Southeast currently has a small number of wind projects, they are a major wind manufacturing hub with more than 100 factories.

**Figure 4. U.S. Wind-Related Manufacturing Facilities, 2016**



Source: AWEA 2017b.

Wind power is providing a significant source of income for many rural communities. AWEA estimates that nearly all wind projects installed through 2015 were located in Census Bureau-designated rural areas, with 70 percent of that development located in low-income counties that fall below U.S. median household income levels (AWEA 2016). The National Renewable Energy Laboratory (NREL) estimates that wind projects have a county-level annual-earnings impact of \$5,000 to \$43,000 per megawatt of installed wind capacity, depending largely on whether the project has a local-ownership component (DOE 2012). This impact—typically in the form of lease, royalty, or right-of-way payments to local landowners—is becoming an increasingly important revenue stream in rural agricultural communities where many wind projects are sited.

With over 98 percent of all projects located on private land, wind energy provided an estimated \$222 million annually in lease payments to landowners in 2015, with more than \$156 million occurring in low-income counties (AWEA 2016). In 2015, wind lease payments provided more than \$50 million in Texas, \$15 million in California, Iowa, and Oklahoma, \$10 million in Illinois and Kansas, and \$5 million in six other states.

State and local governments also collect property and income taxes and other payments from renewable energy project owners. This money is being used by communities to build schools, hospitals, and other important infrastructure. For example, MidAmerican Energy estimates that their new 2,000 MW project in Iowa will generate approximately \$12.5 million in annual property-tax payments for local communities (MidAmerican 2017).

The solar industry is also a major source of new jobs and investment across the U.S. due in large part to federal tax credits. Total industry employment has more than doubled since 2012. More than 51,000 solar workers were added in 2016, bringing the industry total to 260,000 jobs at more than 9,000 businesses located in every state (Solar Foundation 2017). The top 10 states for solar jobs in 2016 are California, which leads the nation with over 100,000 solar jobs, followed by Massachusetts, Texas, Nevada, Florida, New York, Arizona, North Carolina, New Jersey and Colorado. A recent DOE report found that more Americans worked in solar or wind power generation in 2016 than in either nuclear, coal, natural gas, or hydroelectric generation (DOE 2017).

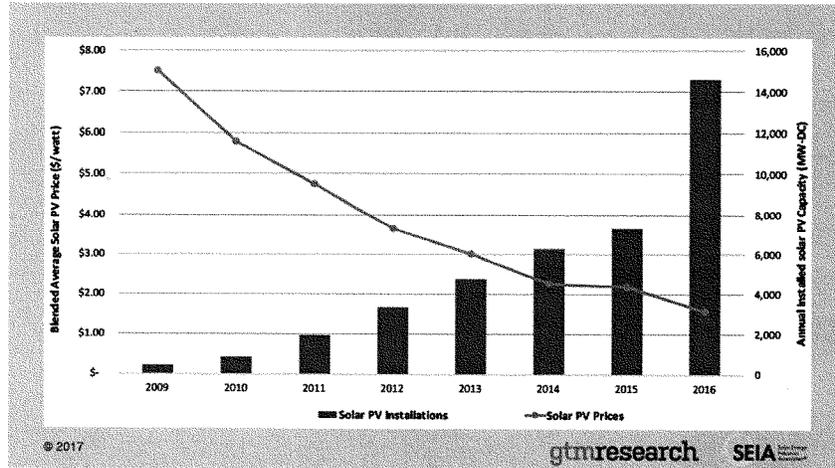
#### **Federal Tax Credits Drive Innovation and Lower Costs**

Improvements in wind turbine technology, particularly taller towers, longer blades and more efficient power electronics, has opened up new opportunities to develop wind power in

places such as the Southeast, which were previously considered economically marginal. These improvements are also resulting in greater wind power output, with capacity factors for new wind projects now exceeding 50 percent at the best locations. Higher capacity factors combined with increased efficiencies and economies of scale in manufacturing, installing, and operating wind turbines, have led to significant cost declines for U.S. wind projects. The total cost of generating electricity from wind power has dropped by more than two-thirds since 2009 (Wiser and Bolinger 2016).

The cost of solar photovoltaics (PV) has also fallen rapidly over the past few years, as the industry has achieved much greater economies of scale in manufacturing and installation. Since 2009, the average installed cost of utility scale and rooftop solar PV systems has fallen by more than 60 percent (SEIA 2017b).

**Figure 5. Solar PV Costs Decline as Deployment Increases**



Source: SEIA 2017b.

**Federal Tax Credits are a Good Deal for Consumers**

The falling costs of wind and solar driven by federal tax credits and state renewable standards has made the cost of renewable more affordable to consumers. Recent analyses show that the benefits of increasing renewable energy use greatly exceeds the costs of federal tax credits. For example, a 2016 NREL and LBNL analysis quantifying the benefits of complying with existing state renewable standards found that renewable energy provided an estimated \$32 to \$165 per megawatt-hour (MWh) in health and environmental benefits from reducing carbon emissions and other air pollutants, with a central estimate of \$75/MWh. This benefit is about three times the current cost of the PTC at \$23/MWh. The study also found that renewables would reduce wholesale electricity prices and natural gas prices, resulting in consumer savings of \$1.3-\$4.9 billion or \$13-49/MWh of new renewable generation. In addition, the study found that renewables would reduce water use from thermoelectric power plants, reduce natural gas price volatility, and create new jobs, but did not assign the economic value to these benefits in the above estimates.

Similarly, DOE's 2015 wind vision study found that increasing wind power to 10 percent of U.S. electricity generation by 2020 and 20 percent by 2030 would result in benefits worth \$41/MWh in avoided health and environmental benefits from avoided air pollution for a modest \$1/MWh or 1% increase in electricity prices in 2030. The study also found that achieving these wind power targets would result in additional \$23/MWh or \$280 billion in consumer savings from reduced natural gas prices due to a reduction in demand for natural gas in the power sector (DOE 2015).

These studies demonstrate that diversifying the electricity mix with renewable energy technologies like wind and solar can also help stabilize electricity prices and lower natural gas prices. These technologies are not subject to fuel price volatility and can offer fixed prices for 20

years or more. In contrast, natural gas prices, which have experienced significant volatility over the last decade, are difficult to lock-in for any significant duration. A 2013 LBNL study comparing prices from a large sample of wind power purchase agreements to a range of long-term natural gas price projections found that wind projects can provide a long-term hedge against natural gas, even in an era of low natural gas prices (Bolinger 2013). While the recent increase in U.S. shale gas production has resulted in lower natural gas prices, it has not eliminated the price volatility. This was readily apparent during the Polar Vortex in January 2014 when natural gas and electricity prices reached record high levels in the Northeast and Midwest due to high natural gas demand for both home heating and electricity generation.

Recent claims that the production tax credit for wind is distorting market prices and adversely affecting other energy sources such as nuclear power are greatly overstated. Analysis by AWEA shows that only a small share of all occurrences of negative prices appear to be linked to wind generation, with low electricity demand and the inflexibility of nuclear plants the primary cause of negative prices (Goggin 2016). Low natural gas prices are the primary cause of the economic challenges facing both nuclear and coal plants, as well as renewable energy projects. While additional wind and solar deployment does have the effect of pushing the generation supply curve out, this has a minimal impact on market prices, as the supply curve in most parts of the country is very flat due to low natural gas prices. In addition, any low-marginal cost generation, like nuclear, hydro, and even coal, can have the same impact as wind and solar.

#### **Strong Federal Policies Are Needed**

Federal tax credits and R&D funding have been an important complement to state renewable standard policies in promoting renewable energy development, driving technology innovation, and lowering costs. As discussed above, they has improved the playing field for

renewables to compete with fossil fuels and nuclear power, which have benefitted from large federal subsidies for decades and market prices that do not reflect many important externality costs from burning fossil fuels. They have also allowed the U.S. to maintain its global leadership in the manufacturing and deployment of renewable energy technologies. Until we can transition to national policies that provide more stable, long-term support for clean, low carbon energy, Congress should extend federal tax credits by at least five more years to maintain the sustained orderly growth of the industry and provide more parity and predictability for renewables in the tax code.

A long-term tax credit extension for renewable energy could also be part of a well-designed technology neutral tax credit that encourages investments in a wide range of low and zero carbon technologies. This would help level the playing until carbon emissions and other externality costs from burning fossil fuels are factored into market prices through other policy mechanisms. Tax credits should also be expanded to encourage investments in energy storage technologies to help accelerate deployment and cost reductions. Deployment of renewable energy, combined with storage, on a large-scale will help dramatically reduce carbon emissions from the power sector, while creating thousands of new jobs. Energy storage technologies can also enable micro-grids to shield communities and critical infrastructure from the disruption of storm-induced power outages. As the costs of energy storage continue to fall, the economic benefits to households, businesses, local communities, and utilities will grow.

#### **Conclusion**

Federal tax credits are a powerful, cost-effective tool for driving significant levels of renewable energy development. In turn, the deployment of wind, solar, and other renewable resources is attracting investments from manufacturers, creating new jobs, and producing

revenue streams for land owners and local communities, all while providing clean energy that reduces air pollution and helps stabilize our climate. Together with state policies, extending federal tax credits and transitioning to stronger federal policies for clean, low-carbon energy can help maintain the nation's momentum toward a clean and prosperous economy.

Thanks again for the opportunity to testify. I'd be happy to answer any questions.

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Mr. UPTON. Thank you.  
Mr. Aldy?

**STATEMENT OF JOSEPH E. ALDY**

Mr. ALDY. Thank you, Chairman Upton, Congressman McNerney, and members of the committee for hosting me today for this testimony. I am an associate professor of Public Policy at the Harvard Kennedy School where my research in teaching focuses on the design, the evaluation, and the rationale for energy and environmental policy. I appreciate the opportunity to speak about energy-tax policy today, and I would like to begin the conversation with suggesting three public policy principles.

First, energy-tax policy should correct market failures. Well-functioning markets do not need government interventions. Indeed, when the Government intervenes in well-functioning markets, we risk government failures that actually make society worse off. Now, if there is too much pollution or too little innovation, then an energy-tax instrument could be a very effective way to remedy this problem.

Second, energy-tax policy should promote cost effectiveness. If the policy targets the market failure cost effectively, then we can make the American people, businesses, consumers better off. Taxpayers should get the biggest bang for their tax expenditures, because one firm's tax benefit or tax preference in the tax code is implicitly financed by another firm's or family's taxes.

Third, reviewing the impacts of tax instruments can inform the design and potential reform of energy-tax policy. When we think about the implementation of energy policy and environmental policy that has impacts on the energy sector we see a really big disconnect between how we review energy policy that is subject, say, to regulation which typically then is subject to benefit-cost analysis, public comment, and congressional review; whether the instrument of implementation is spending, which is subject to congressional oversight and agency evaluation; or tax instruments, which typically are subject to very little review and analysis.

And I think that is why it is really important for this committee to look at the role of energy-tax instruments in energy policy. We should be very comprehensive in our assessment of what are the most effective ways to deliver on our social goals through energy policy and assess whether the best way forward is through the tax code, through regulation, through spending, or by recognizing that the private market may be best left on its own.

In my written testimony I illustrate principles in my review of fossil fuel tax expenditures including the expensing of intangible drilling costs, percentage depletion, the manufacturing deduction for oil and gas, and other hydrocarbon subsidies in the tax code. I show how these fossil fuel tax expenditures fall short on each of these principles. The current slate of fossil fuel subsidies do not target an externality, although some past subsidies, for example the unconventional natural gas production tax credit, I think, was important in helping to promote and address concerns associated with innovation.

Indeed, when we look at the fossil fuel subsidies in the tax code today, they have the potential to increase the production of socially

harmful externalities such as air pollution that contributes to premature mortality and carbon dioxide emissions that contribute to climate change. Moreover, retaining fossil fuel subsidies may undermine reform of fossil fuel subsidies around the world. We have, as a government, worked with a number of other countries to try to get them to reform their fossil fuel subsidies in a way that would benefit us both economically and environmentally, because if developing countries around the world reduce their fossil fuel subsidies it actually lowers oil prices in the United States and lowers global carbon dioxide emissions.

Since fossil fuel subsidies do not correct market failures, by definition they cannot deliver on the objective of being cost effective. And the research literature shows that these subsidies don't meaningfully impact production so they don't really help us much when we look at the price of gasoline at the pump, so we are spending taxpayers' monies without much to show for it when we look at the hydrocarbon subsidies.

Finally, I would note and as has been already noted in this hearing, fossil fuel tax expenditures do not have a sunset provision. A future reform could set sunset provisions which would create milestones that can motivate evaluation of effectiveness of the policy, and these provisions could leverage the democratic process so that the case could be made for continuing, reforming, or eliminating the policy intervention. Let me also suggest that we could task some of the experts we have in the Government, CBO, EIA, and other agencies, to analyze and review energy-tax expenditures in order to inform the public debate about energy-tax policy.

And let me close by noting that if we really want to maximize social welfare to make Americans as well off as possible, we want to look for ways to transition from the second best subsidy instruments that are the norm in the tax code on energy and instead transition to a world in which we have direct pricing on the externalities associated with energy. Such policies could be implemented in a way that clearly corrects the externality, does so cost effectively, and can enable, review, and reform over time. It would provide tax revenues that could enable major reductions in business and personal income taxes, and by taxing bad things like pollution and reducing taxes on good things like labor and investment, we could promote faster economic growth, higher levels in employment, and a cleaner environment. Thank you, Mr. Chairman.

[The prepared statement of Mr. Aldy follows:]

Statement of Joseph E. Aldy  
Associate Professor of Public Policy, Harvard Kennedy School  
Visiting Fellow, Resources for the Future  
Faculty Research Fellow, National Bureau of Economic Research  
Senior Adviser, Center for Strategic and International Studies

*To be presented to:*

United States House Committee on Energy and Commerce, Subcommittee on Energy, hearing on  
“Federal Energy Related Tax Policy and Its Effects on Markets, Prices, and Consumers”

March 29, 2017

Thank you Chairman Upton and Ranking Member Rush and members of the Subcommittee on Energy for inviting me to speak today.

My name is Joe Aldy, and I am an Associate Professor of Public Policy at the Harvard Kennedy School. My research and teaching focus on the rationale for, design, and evaluation of energy and environmental policy.

The Federal tax code has subsidized energy through tax expenditures for more than a century. The focus, scale, and design of energy tax expenditures have evolved over time. Nonetheless, the federal tax code today includes an array of energy- and technology-specific provisions intended to subsidize the investment and production of energy as well as investment in energy-efficient equipment. These subsidies have influenced energy and power markets, energy prices and energy innovation, and air pollution and other environmental outcomes in the United States. They also could play an important role in enabling comprehensive tax reform in which tax expenditures favoring specific interests and activities are exchanged for lower tax rates on personal and business income.

#### **Policy Principles**

Before considering the impacts of subsidizing energy through the tax code, let me offer three public policy principles for assessing the merits of energy tax provisions.

*Correct Market Failures:* Well-functioning markets do not need government interventions. Indeed, government interventions in markets operating efficiently risk introducing inefficiencies that reduce social welfare; i.e., they are government failures. If a market is suffering from a market failure, then a policy intervention could be merited. For example, if energy firms fail to account for the social costs of their pollution—such as emissions of fine particulates that increase premature mortality or carbon dioxide that contributes to climate change—then an energy tax instrument could address the market failure and increase social welfare. Or, if businesses underinvest in innovative activity in energy markets, because they may not be able to fully appropriate all of the benefits of innovation (the so-called public good problem in innovation), then an energy tax instrument could also address the market failure and improve social welfare.

*Promote Cost-Effectiveness:* A market failure is not sufficient to justify government intervention. An energy tax instrument should also be well-designed to mitigate the market failure. If the policy targets the market failure effectively, then it can make society better off. Given various options for the design of tax instruments, the most cost-effective instrument for correcting a market failure should be pursued. Since tax expenditures represent foregone revenues that must be made up by taxes elsewhere in the economy, cost-effective design ensures that the American taxpayer gets the biggest possible social return for a given tax expenditure.

*Review and Reform:* Understanding the impacts of tax instruments—on revenues but also on social outcomes of interest—can inform the design and potential reform of energy tax policy. Beyond estimating foregone revenues, it is uncommon for the government to estimate the impacts of energy tax provisions on externalities, innovation, or measures of economic activity (such as energy production, economic output, or employment). While energy tax policy could be an alternative to regulatory policy in correcting market failures, they differ considerably in terms of their evaluation. Under regulatory policy, detailed benefit-cost analyses are the norm for rules with economic impacts in excess of \$100 million annually. Many energy tax instruments have foregone revenues well in excess of this standard, but they have been subject to little analysis beyond their revenue estimates.

These principles are intended to guide the design and implementation of policy to maximize social welfare. In other words to make the entirety of the American population better off. There may be other important policy objectives, such as stimulating economic activity during periods of deep recession or redistributing resources to help the needy. I would suggest that economic stimulus is not highly effective during this current time with the unemployment rate below 5% nationally and, if it were, there are reasons why subsidizing investment in a capital-intensive industry may not deliver the biggest bang for your stimulus buck. And in terms of assisting the needy, I would suggest that other policies—such as the Low Income Home Energy Assistance Program—can target those most in need more effectively than subsidies for producing energy.

To illustrate these three policy principles for energy tax policy in practice, I will focus on an array of tax expenditures that subsidize oil, natural gas, and coal production as a case study.<sup>1</sup> Let me first describe these instruments and their impacts on production before turning to the questions of whether they correct market failures, promote cost-effectiveness, or facilitate review and reform.

#### **Description of Fossil Fuel Tax Expenditures**

As far back as 1913—the year a constitutional amendment legalized the income tax—fossil fuel extraction companies have received tax breaks that subsidize their activities. Most of these tax code provisions lower the cost of investing in oil, gas, and coal development projects, and they all lower in a preferential manner the corporate tax rate on a specific source of income (i.e. picking winners through the tax code). Historically, the three largest tax expenditures are the expensing of intangible drilling costs, percentage depletion for oil and gas wells, and the domestic manufacturing tax deduction for oil and gas. The eligibility and generosity of these programs differ between integrated companies – those that produce and refine oil and market petroleum products – and independent companies – those that only operate upstream in the extraction of oil and gas. Thus, supermajors such as ExxonMobil, BP,

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<sup>1</sup> This case study draws from my previously published work in Aldy (2013, 2014, 2017b).

Chevron, and Royal Dutch Shell, that extract, refine, and retail oil can claim fewer subsidies per barrel of oil extraction than independent (and especially small independent) oil companies.

In the US tax code, a firm investing in a capital project—say a new factory or office computers—typically depreciates the investment costs over the useful life of the capital. In contrast, oil and gas firms expense all or most of their drilling-related expenditures that do not have salvage value, referred to as intangible drilling costs that typically include geological surveying, wages, fuel, repairs, and supplies associated with well development, in lieu of depreciating them over the economic life of a well. As a result, the provision effectively lowers the tax rate on income from such projects relative to capital investments elsewhere in the economy, distorting investment decisions. This has led to inefficiently low investment outside of the oil and gas sector and inefficiently high investment within the oil and gas sector.

The provision specifically allows independent oil companies to expense all of their intangible drilling costs, while integrated oil companies can expense up to 70 percent of these costs and must depreciate the balance over five years. This skews investment in oil and gas development away from integrated oil firms and toward independent oil companies, although there is no public policy rationale for orienting development to one type of oil firm over another.

Since 1926, firms have had the choice of using cost depletion—writing off the initial costs of acquiring an oil and gas field over that field's production lifetime—or percentage depletion—deducting a percentage of revenues from oil and gas sales—to reduce their tax liabilities. While the former is consistent with standard depreciation practices for other industries, the latter may have little to no relationship to actual project costs because revenues reflect crude oil prices, which are driven by the oil market. When firms choose percentage depletion—which is more generous to oil and gas producers when oil prices are high, due to higher revenues—they enjoy a subsidy relative to standard tax depreciation rules.

The percentage depletion tax provision also disproportionately benefits smaller firms. The oil and gas firms producing less than 1,000 barrels per day may deduct a percentage of their revenues, while firms with larger volumes must deduct the capital cost of the wells. Indeed, with high oil prices, small firms may be able to claim deductions through percentage depletion over the life of a well that significantly exceed the capital cost of the well. In contrast to some oil tax expenditures that phase out with higher oil prices, such as the credit for enhanced oil recovery projects, the effective subsidy from percentage depletion increases as oil prices rise. This also lowers the effective tax rate on these projects and skews investment away from non-oil and gas capital projects and oil and gas development by larger and integrated firms.

In 2002, a World Trade Organization ruling found that US tax law effectively subsidized manufacturing exports and thus violated the international agreement regarding trade and subsidies. As a result, Congress struck the WTO-illegal tax provision and replaced it with a domestic manufacturing tax deduction. While oil and gas development are not part of the manufacturing sector nor was the United States a meaningful exporter of either oil or gas at the time, Congress determined that these activities could also claim the manufacturing tax deduction. This provision permits oil and gas producers to claim a 6 percent deduction and a related provision allows coal producers to claim a 9 percent deduction of taxable income. Like the other subsidies, this provision provides a lower rate on a favored source of income.

The enhanced oil recovery tax credit increases revenues from production that uses carbon dioxide or other tertiary methods to recover crude oil and natural gas from older, more depleted oil and gas fields. In contrast to percentage depletion, this subsidy becomes less generous—and declines to zero—under high oil prices because the credit phases down as prices increase. With lower oil prices now forecast going forward, the foregone revenue score for this tax expenditure is larger than in past year's Treasury forecasts. These four provisions represent more than 90 percent of fossil fuel tax expenditures, as summarized in Table 1.

Table 1. Provisions of the U.S. Tax Code that Subsidize Fossil Fuel Extraction

Tax Provision	10-Year Revenue Score (billions)
Expensing intangible drilling costs	\$10.0
Domestic manufacturing tax deduction for oil and gas	\$9.1
Enhanced oil recovery credit	\$8.8
Percentage depletion for oil and gas wells	\$5.0
Increase geological and geophysical expenditure amortization for independents	\$1.5
Percentage depletion for hard mineral fossil fuels	\$1.1
Capital gains treatment for royalties	\$0.5
Expensing of coal exploration and development costs	\$0.3
Domestic manufacturing tax deduction for coal	\$0.2
Deduction for tertiary injectants	\$0.1
Exception for passive loss limitations for working interests in oil and gas properties	\$0.1
Credit for oil and gas produced from marginal wells	\$0
<b>Total</b>	<b>\$36.7</b>

Notes: The last provision in this table is not expected to have a revenue impact because it phases out at oil prices below the levels expected over the 10-year scoring window.

Source: Summary Tables S-9, FY2017 Administration Budget, Office of Management and Budget.

#### Do Fossil Fuel Tax Expenditures Promote Fossil Fuel Production?

Empirical evidence on the effect of tax expenditures on oil and gas production is limited. Economic theory suggests that tax expenditures to subsidize investment lower the user cost of capital for firms. This implies higher usage of capital in equilibrium and accelerated net investment at the time of a tax change. Changes in investment (i.e., drilling) can then result in changes to future production (e.g., Anderson et al. 2014). To understand how firms' investments could change if these tax expenditures are

repealed, it is important to quantify how a firm's investment incentive varies with the subsidies. For example, Metcalf (2010) calculates the effective tax rates for firms in the energy sector. For oil drilling firms, he shows that the effective tax rate for non-integrated firms is -13.5%, and 15.2% for integrated firms. He finds that removing the intangible drilling costs expensing and the percentage depletion deduction provisions, then their effective tax rates rise to the statutory rate that combines both Federal and (average) state corporate taxes of 39.9%. Whether such large changes in the effective tax rate substantially impact firms' drilling decisions is an empirical question.

While there has been very little research published in the peer reviewed literature on the empirical impacts of reforming oil and gas tax expenditures, there are several papers and reports that have received considerable attention in this policy debate. For example, as Chief Economist of the Department of the Treasury, Alan Krueger testified before Congress on the impacts of eliminating fossil fuel tax expenditures in 2009. Krueger (2009) stated that the Treasury Department estimated a less than 0.5 percent decline in domestic oil production (and comparable effect on oil and gas extraction employment) as a result of phasing out these subsidies. He noted that it would have an insignificant impact on oil prices. Krueger pointed out that since small independent firms are the main beneficiaries from these tax expenditures, eliminating these tax expenditures could shift production from independent drilling companies to the large integrated firms that also engage in refining and marketing petroleum products (Krueger 2009).

A Bloomberg Government report (Costello 2009) estimated that a repeal of all oil and tax expenditures would not affect larger integrated producers but would reduce drilling by independents. On net, total domestic drilling would fall 3.7% in this study. A Wood Mackenzie (2013) report commissioned by the American Petroleum Institute, the oil and gas industry's trade association, estimated that repealing intangible drilling costs expensing would result in 3,300 fewer wells drilled each year (approximately 20% of drilling activity in 2012). In neither study are the methods and data sufficiently transparent to permit a replication or proper description here.

Several studies, including Allaire and Brown (2009, 2012) and National Research Council (2013) employed the U.S. Energy Information Administration's National Energy Modeling System (NEMS) to estimate the impacts of eliminating oil and gas tax expenditures. Allaire and Brown estimated a reduction in domestic production of 26,000 barrels per day (about 0.3% of 2016 production). The NRC focused on the impacts of eliminating percentage depletion for domestic natural gas production, and found that in doing so domestic extraction of natural gas would fall by about 0.5%.

Some more recent studies suggest the impacts on hydrocarbon production could be modestly larger. For example Metcalf (2016) develops and calibrates a model that indicates that long-term US oil production would be about 5% lower than it would be otherwise. This would still be well above our post-World War II trough in domestic production realized in 2008. As in other studies, the impact on oil prices estimated in Metcalf (2016) would be negligible – a change of ½ to 1 percent, which at today's oil prices would translate to about 1 penny per gallon of gasoline.

#### **Do Fossil Fuel Tax Expenditures Correct Market Failures?**

The subsidies listed in Table 1 do not focus on innovative or pollution-reducing activities. In other words, they neither address externalities nor the public good nature of innovation. They indiscriminately lower the cost of investing in another oil and gas field or another coal seam. These tax expenditures distort

and subsequently lower the return on investment across the US economy. In addition, by reducing tax revenues from resource extraction, these subsidies must be effectively financed by taxes elsewhere in the economy, which may further reduce non-fossil fuel investment. By distorting investment decisions in the economy, such tax expenditures are a government failure.

Moreover, subsidizing fossil fuels—to the extent that they could increase the production of fossil fuel based energy—could exacerbate market failures. If these tax expenditures increase oil and coal production, then emissions of fine particulates that contribute to premature mortality and of carbon dioxide that contribute to climate change could increase (Erickson et al. 2017). Potentially increasing socially-harmful externalities would illustrate how fossil fuel tax expenditures are a government failure on a second dimension.

Removing tax instruments that represent a government failure would make American society better off. In addition, taxpayers' returns to eliminating these subsidies could be much larger when considering how such efforts could leverage reforms of fuel pricing in countries around the world. At the 2009 Pittsburgh G-20 summit, the United States spearheaded an agreement among the leaders of the twenty largest developed and developing economies to phase out fossil fuel subsidies. While this agreement continues to receive attention at G-20 meetings, including formal peer review processes, the progress in delivering on this objective has been mixed. This includes the fact that Congress has failed to act on proposals to eliminate fossil fuel tax expenditures since 2009. Leadership via the action of eliminating these subsidies would empower the United States to encourage other large developed and developing economies to reduce their subsidies (Aldy 2015).

Eliminating fossil fuel subsidies in the developing world – which typically support consumption through lower-than-market prices – would yield significant economic, energy, and environmental benefits. Global oil consumption could fall more than 4 million barrels per day, which would lower crude oil prices and benefit consumers in the United States and countries around the world. Global carbon dioxide emissions contributing to climate change could fall by 10 percent through a policy that would, on net, increase economic output by removing costly distortions in developing economies (Aldy 2014, 2015). Let me emphasize these results: if we demonstrate our leadership and engage with our economic partners around the world to remove fossil fuel subsidies, then *American consumers would enjoy lower gasoline, diesel, and heating oil prices and the world would enjoy lower carbon pollution*. This would clearly be a policy winner.

Let me close by noting that a well-designed fossil fuel tax expenditure could help address a market failure and increase social welfare. Some subsidies may target novel technologies and facilitate innovative activity. For example, the now-expired unconventional natural gas production tax credit provided support for nascent shale gas exploration technologies in the 1980s and 1990s. One could imagine that a tax credit for investment in emerging carbon capture and storage technology for fossil fuel-fired power plants could also be justified on social welfare grounds. This could be integrated in the reform of the enhanced oil recovery tax credit, in which the tax credit is based on the amount of carbon dioxide stored underground as opposed to barrels of oil production.

#### **Are Fossil Fuel Tax Expenditures Cost-Effective?**

Since these tax expenditures do not remedy market failures, by definition they cannot be a cost-effective approach to correcting market failures. In addition, given the very small impacts on production,

they would appear to be a costly way to increase production. Between 2008 and 2016, U.S. oil production increased more than 75 percent. This is not because of any changes in these tax expenditures (there were no changes to these tax provisions during this time), but is a result of the innovation in the industry driving down extraction costs and higher oil prices than what we experienced in the 1990s and 2000s. Based on the Allaire and Brown analysis, the government may be spending billions of dollars per year for about 26,000 barrels per day. If an oil company spent that much money for such a small amount of production, it would go out of business.

#### **Are There Opportunities for Review and Reform of Fossil Fuel Tax Expenditures?**

In contrast to many energy tax provisions, these fossil fuel tax expenditures do not have a sunset provision. They are a part of the tax code until Congress takes action to change them. Sunset provisions create milestones that can motivate evaluation of the effectiveness of policy. These provisions leverage the democratic process so that the case can be made for continuing, reforming, or eliminating the policy intervention. A modest reform would be to include sunset provisions on these tax expenditures in order to motivate such a debate over their merits.

As noted previously, there is much less rigorous review of the impacts of tax provisions intended to address market failures than for regulatory interventions in the federal government. Given the expertise in the Federal government, for example at the Congressional Budget Office and the Energy Information Administration, it would benefit the public debate about energy tax policy to task these experts to evaluate the impacts of these fossil fuel tax expenditures. For that matter, this analysis could address all energy tax policy. Such an analysis could address an array of important questions: What are the incremental impacts of a given tax instrument on production? What are the incremental impacts of multiple, overlapping tax expenditures? What impacts do these tax expenditures have on energy prices? What are the distributional impacts of energy tax expenditures? What effects do these instruments have on innovation and the production of knowledge? What are the impacts of the tax expenditures on air pollution, such as fine particulate matter and carbon dioxide? How do tax expenditures interact with other policy instruments, such as spending and regulations, to affect markets, consumers, and pollution? Rigorous, independent analysis of these questions could substantially improve the policy debate about energy tax policy and inform potential reform of energy tax expenditures and comprehensive tax reform more generally.

#### **Conclusions**

In light of this analysis, I have previously proposed eliminating fossil fuel tax expenditures on several occasions (Aldy 2013, 2014, 2017b). I recognize that the political economy of reforming these subsidies is more complicated than evident in an analysis of how they reduce social welfare. As the University of Chicago economist George Stigler noted in his seminal paper on how industry captures the benefits of government intervention: “The most obvious contribution that a group may seek of the government is a direct subsidy of money” (Stigler 1971, p. 4). Once firms have secured such subsidies, especially those narrowly tailored to their activities, then they have a strong vested interest in the continuation of these subsidies.

Some recipients of these subsidies may dispute that they are in fact subsidies. While this cannot be squared with how the tax code preferentially favors investment in fossil fuel projects relative to other

industries, there is an active debate about the definition of fossil fuel subsidies. For example, the International Monetary Fund employs two definitions of fossil fuel subsidies. The first definition is in line with what I have described above. The second definition, however, includes the fact that we fail to fully account for the adverse impacts of pollution from fossil fuel combustion on premature mortality and climate change. On this measure, the U.S. fossil fuel subsidies are several orders of magnitude larger than what is reported in Table 1 and represent the largest fossil fuel subsidies of any country in the world (IMF 2015; Aldy 2015). Such an approach would be consistent with a general policy objective – regardless of whether it is implemented through a tax instrument or regulation or alternative policy approach – to appropriately price the external costs of energy production and use (Greenstone and Looney 2012).

This highlights the fact that U.S. energy tax policy subsidizes technology- and energy-specific investment. It is still second-best to using the tax code to price the externalities in our production and consumption of energy. As my colleague in the Harvard economics department Dale Jorgenson (2012) has noted, doing so could deliver very large social gains through improving environmental quality and increasing the efficiency of the tax code. Pricing pollution in the tax code could generate the revenues that would enable more ambitious lowering of tax rates on families and businesses (Morris 2013; Taylor 2015; Aldy 2016). Such policies could be implemented in a way that clearly corrects an externality, does so cost-effectively, and could enable review and reform over time (Aldy 2017a). This would represent a significant improvement over a status quo in which we spend money on tax expenditures that do not increase social welfare and impose real opportunity costs on society by requiring higher taxes elsewhere in the economy. Evidence-based reform of energy tax policy could increase returns to the American taxpayer and make the whole of American society better off.

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Mr. UPTON. Thank you.  
Dr. Zycher?

#### STATEMENT OF BENJAMIN ZYCHER

Dr. ZYCHER. Thank you, Mr. Chairman. I would like to emphasize two points today. First, it is the tax subsidies for unconventional energy that, by far, have the most detrimental effects on markets, prices, and consumers. Second, the various rationalizations offered over the last 4 decades in support of those Federal tax subsidies are exceptionally weak analytically. The central question always to be asked is, Does a tax provision improve economic well-being, that is, the productivity of resource use, defined broadly? The subventions for various unconventional forms of energy and electricity create resource waste and reduce economic well-being.

Wind and solar power in particular cannot compete without large subsidies and guaranteed market shares, and it is clear that higher market shares for such power have driven electricity rates upward. This is particularly the case given the need for expensive backup generation to avoid blackouts and the need for extra transmission capacity due to the geographic limitations of unconventional generation.

Moreover, the subsidized expansion of wind and solar power is likely to increase rather than to reduce emissions of conventional effluents and greenhouse gases, in particular because of the up and down cycling of conventional backup units needed to preserve system reliability. Clean power is clean only if we ignore the adverse environmental effects of wind and solar power.

The various tax provisions for conventional energy in general are not subsidies defined properly. And with the exception of the clean coal tax credit and perhaps a few others, they may or may not improve the efficiency of resource allocation depending on various underlying conditions.

Let me turn to the various rationales offered over the last 4 decades in support of energy-tax policies. Energy independence, the degree of self-sufficiency in terms of energy production, is irrelevant analytically because the price effects of supply disruptions are independent of the degree of self-sufficiency, and such secondary effects as exchange rate shifts are not relevant for policy making.

The infant industry rationale for renewable subsidies is a non sequitur because capital markets can sustain promising industries or technologies in their infancy. There is no analytic evidence that renewables suffer from a subsidy imbalance relative to competing conventional energy technologies, even if we put aside how the word subsidy is defined. Quite the reverse is true. Per unit of energy production, renewable subsidies are vastly larger. The level playing field argument is simply not correct.

The sustainability or resource depletion argument for renewable subsidies is incorrect as market forces provide powerful incentives to conserve resources for consumption during future periods. The green jobs employment rationale for renewable subsidies does not make analytic sense, as a resource shift into the production of politically favored power must reduce employment in other sectors and the taxes needed to finance the subsidies cannot have favorable employment effects. Moreover, the historical evidence on the

relationships among GDP, employment, and energy consumption does not support the green jobs argument.

Finally, the social cost of carbon argument promoted by the Obama administration was deeply flawed. Indeed that estimate of about \$40 per ton in year 2016 dollars was the single most dishonest exercise in political arithmetic that I have ever seen produced by the Federal bureaucracy. Moreover, the policies previously proposed to reduce emissions of greenhouse gases would have temperature effects trivial or unmeasurable even at the international level using the EPA's own climate model.

It would be hugely productive for the U.S. economy were policy-makers to assume that resource allocation in energy sectors driven by market prices is roughly efficient in the absence of two compelling conditions. First, it must be shown that some set of factors has distorted those allocational outcomes to a degree that is substantial and that have not been addressed with other policy interventions. Second, it must be shown that government actions with high confidence will yield net improvements in aggregate economic well-being.

Thank you again, Mr. Chairman, and I will be very pleased to address any questions that you and your colleagues may have.

[The prepared statement of Dr. Zycher follows:]



Statement before the House Committee on Energy and Commerce  
Subcommittee on Energy  
On Federal Energy-Related Tax Policy and Its Effects on Markets, Prices, and  
Consumers

## **Do Federal Energy-Related Tax Policies Improve Economic Wellbeing?**

**Benjamin Zycher**

John G. Searle Chair and Resident Scholar, American Enterprise Institute

March 29, 2017

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## Do Federal Energy-Related Tax Policies Improve Economic Wellbeing?

Benjamin Zycher\*

### Summary

Policymakers should ask a straightforward question when considering the enactment or preservation of a given tax policy or provision: Does it make the economy---the total size of the aggregate economic "pie" defined broadly---larger? Or: Does the given policy actually correct for inefficiencies in resource use created by other government policies or by certain market conditions? At a practical level, the issue of whether a given tax (or other) policy has a net positive effect usually can be answered by examining the central justifications given for the policy. In the context of federal energy-related tax policy, those justifications often are weak or incorrect.

Accordingly, the focus of this hearing on "markets, prices, and consumers" is appropriate, in that it implicitly asks *whether federal energy-related tax policies make the economy bigger rather than smaller*. By "economy," again, we must mean the economic pie defined broadly to include environmental values and other parameters not captured well in market prices. That is the correct question for policymakers. At a conceptual level, the issue of whether a given tax (or other) policy has a net positive effect usefully can be answered by examining the central justifications given for the policy.

Among the central energy-related tax provisions now in effect, the subventions for various unconventional forms of energy and electricity are subsidies defined properly, and in general are likely to be inefficient, that is, they are likely to yield resource waste and thus to make the economy smaller. The various tax provisions for conventional energy in general are not subsidies defined properly, with one exception, but may or may not improve the efficiency of resource allocation depending on various underlying conditions.

The modern rationales for energy subsidies have varied in prominence over the decades, ranging from "energy independence" through the "social cost of carbon." Each suffers from fundamental analytic weaknesses.

Energy "independence"---the degree of self-sufficiency in terms of energy production---is irrelevant analytically. Capital markets can sustain promising industries or technologies in their infancy, so that the "infant industry" rationale for renewables subsidies is a *non sequitur*. There is no analytic evidence that renewables suffer from a subsidy imbalance relative to competing conventional energy technologies. "Renewable" electricity capacity and generation create their own set of environmental problems, and even in terms of conventional effluents and greenhouse gases it is far from clear that they have an advantage relative to conventional generation, particularly because of the up-and-down cycling of conventional backups units

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\* John G. Searle Chair and Resident Scholar, American Enterprise Institute. The views expressed in this prepared statement and at the hearing referenced above, delivered both directly and in response to the questions and comments offered by others, are my own, and do not purport to represent those of AEI. My contact information is: [benjamin.zycher@aei.org](mailto:benjamin.zycher@aei.org) and 202-862-4883.

needed to preserve system reliability. Moreover, those backup costs are substantially larger than the externality costs of conventional power even under extreme assumptions. The “sustainability” or resource depletion argument for renewables subsidies is incorrect, as market forces provide powerful incentives to conserve resources for consumption during future periods.

The “green jobs” employment rationale for renewables subsidies does not make analytic sense, as a resource shift into the production of politically-favored power must reduce employment in other sectors, and the taxes needed to finance the subsidies cannot have salutary employment effects. Moreover, the historical evidence on the relationships among GDP, employment, and electricity consumption does not support the “green jobs” argument. Finally, the “social cost of carbon” argument is deeply flawed both conceptually and in terms of the quantitative estimates underlying the recent regulatory effort. The policies previously proposed to reduce emissions of greenhouse gases would have temperature effects trivial or unmeasurable even at the international level. More generally, the terms “carbon” and “carbon pollution” are political propaganda, as carbon dioxide and “carbon” are very different physical entities, particularly given that some minimum atmospheric concentration of the former is necessary for life itself.

It would be hugely productive for the U.S. economy writ large were policymakers to adopt a straightforward operating assumption: Resource allocation in energy sectors driven by market prices is roughly efficient in the absence of two compelling conditions. First: It must be shown that some set of factors has distorted those allocational outcomes to a degree that is substantial. Second: It must be shown that government actions with high confidence will yield net improvements in aggregate economic outcomes. Given the weak history of analytic rigor and policy success in the context of energy subsidies, greatly increased modesty on the part of policymakers would prove highly advantageous.

#### I. Introduction: An Economic Principle to Guide Policymaking

Policymakers should ask a straightforward question when considering the enactment or preservation of a given tax policy or provision: Does it make the economy---the total size of the aggregate economic “pie” defined broadly---larger? Or: Does the given policy actually correct for inefficiencies in resource use created by other government policies or by certain market conditions?

A market economy as a matter of principle preserves economic freedom by allowing individual preferences to determine the prices that drive the allocation of resources among competing uses. That fundamentally is a “bottom-up” process very different from a system of centralized allocation decisions made in a “top-down” manner by government decisionmakers. Because it is individual preferences that are reflected in market prices, those prices reflect the “opportunity cost” of specific resource uses: the value that individuals taken collectively would place upon the use of the marginal units of the given good or input in their most valuable alternative employment.

That is why the output of a market economy is measured by the market prices of the vast array of the final goods and services produced, multiplied by the respective quantities. That “gross domestic product”---the market value of the final goods and services produced by domestic residents---can be thought of as the size of the aggregate “pie,” but that is too narrow in a policy context, as it excludes important values not captured in reported market prices. A good example is the value of environmental conditions in many contexts.<sup>1</sup> Another is the value of the home services not priced in observable markets. Inefficiencies introduced by government activities or by certain market conditions have the effect of reducing the value of the aggregate pie, that is, the total value of the goods and services available for individuals to consume. Efforts to correct for such government activities or market conditions themselves are not costless in terms of resource consumption or the erosion of other values, among them the preservation of limited government.<sup>2</sup> Accordingly, not all such market “imperfections” can be corrected at a cost sufficiently low to justify the given government action.

Accordingly, the focus of this hearing on “markets, prices, and consumers” is appropriate, in that it implicitly asks *whether federal energy-related tax policies make the economy bigger rather than smaller*. By “economy,” again, we must mean the economic pie defined broadly to include environmental values and other parameters not captured well in market prices. That is the correct question for policymakers. At a conceptual level, the issue of whether a given tax (or other) policy has a net positive effect usefully can be answered by examining the central justifications given for the policy.

In the context of federal energy-related tax policy, those justifications uniformly are weak or incorrect. Section II lists several federal energy-related tax policies, and discusses at a qualitative level whether they can be predicted to improve resource allocation in the aggregate, that is, whether they are likely to make the economic pie larger or smaller. Section III offers a brief history of modern U.S. energy subsidies, which include both tax policies and nontax initiatives. Section IV describes the central rationales usually offered in support of energy subsidies, as embodied in both tax and nontax policies, and discusses the analytic merits of each. Section V does the same for the “social cost of carbon” rationale. Section VI offers some concluding observations.

## II. Several Energy-Related Tax Policies

The discussion here is limited to the energy tax provisions that engender a revenue loss of \$1 billion or more over fiscal years 2015-2019, as estimated in a recent report from the Congressional Research Service.<sup>3</sup>

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<sup>1</sup> Note that environmental values may be reflected in whole or in part indirectly by other market prices. An example is differentials in land values affected by differing ambient environmental conditions.

<sup>2</sup> We could reduce crime more effectively were we to ignore the 4<sup>th</sup> amendment requirement for search warrants based upon probable cause. We accept some additional crime so as to avoid some expansion of government power.

<sup>3</sup> See Molly F. Sherlock and Jeffrey M. Stupak, “Energy Tax Policy: Issues in the 114<sup>th</sup> Congress,” Congressional Research Service Report R43206, June 15, 2016, at <https://fas.org/sgp/crs/misc/R43206.pdf>. See also the discussion from the Joint Committee on Taxation at <https://www.jct.gov/publications.html?func=startdown&id=4415>.

*Percentage depletion allowance for oil and gas production.* The percentage depletion allowance essentially is a form of depreciation for the capital assets represented by extractive resource geologic formations; this tax treatment is available to all extractive industries.<sup>4</sup> It may or may not be the case that a particular legal depletion percentage (usually 15 percent in this context) is correct analytically---the allowance can result in a deduction in excess of the incurred capital costs---but the percentage depletion allowance as a method for the depreciation of an extractive capital asset conceptually is not a "subsidy." Since percentage depletion is allowed all extractive industries, the neutrality principle suggests that it be available to all or to none; in the latter case, cost depletion is the obvious alternative. Note that cost depletion, because it is based upon historical accounting costs rather than economic (or opportunity) costs, creates its own set of potential distortions.

*Expensing of intangible drilling costs.* The accelerated tax deduction for intangible drilling expenses allows expensing of labor and other drilling costs associated with exploration activities.<sup>5</sup> Since those costs are incurred in the creation of a capital asset, the basic analytics of income taxation require that such costs be capitalized and depreciated over time. This problem, however, does not represent a "subsidy" specific to conventional energy production, as this tax provision is very similar to the tax treatment of research and development costs in other industries. The allowed expensing of materials injected into declining wells so as to enhance extraction is appropriate, because the materials are consumed in the extraction process; they do not, therefore, help to create capital assets. Accordingly, this tax treatment again is not a "subsidy" specific to oil and gas production, although it may be inefficient economically. This inefficiency condition may be offset by the problem posed by an expectation of a positive likelihood of price controls during a future supply disruption or other perceived emergency, as discussed immediately below.

*Section 199 deduction for goods production.* The "Section 199" deduction of 9 percent of income is a tax preference given almost all U.S. producers of goods (but not services). This deduction for producers of goods may or may not be sound tax policy, but it is not specific to conventional energy producers---which receive only a 6 percent deduction---and so it is not a "subsidy" for such producers relative to other producers of goods. To the extent that goods producers with significant physical stocks of capital face some prospect of price controls during future wars or other emergencies, this deduction may be efficient in terms of inducing an optimal level of investment in such industries during peacetime. The expectation (with some probability greater than zero) of future price controls would suppress investment below efficient levels because the presence of significant physical capital stocks specialized to specific production activities creates "quasi-rents" available for government to extract with price controls, without suppressing production in the short run.<sup>6</sup>

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<sup>4</sup> Note that integrated oil companies---those that both produce and refine petroleum---are not allowed this tax benefit; they are required to use cost depletion based upon the adjusted cost basis of the assets.

<sup>5</sup> This deduction is reduced for integrated oil companies, which are allowed to expense 70 percent of such costs, with the remainder deducted over the ensuing five years.

<sup>6</sup> See Earl A. Thompson, "Taxation and National Defense," *Journal of Political Economy*, Vol. 82, No. 4 (July-August 1974), pp. 755-782; and Earl A. Thompson, "An Economic Basis for the 'National Defense Argument' for Aiding Certain Industries," *Journal of Political Economy*, Vol. 87, No. 1 (February 1979), pp. 1-30.

*Foreign tax credit.* The foreign tax credit is a tax provision designed to avoid double taxation of U.S. firms operating both domestically and overseas. Whatever the issues inherent in the allocation of costs and revenues across operations in different geographic locales, or the possible classification of royalty payments as “income taxes”, the tax credit is not a “subsidy” in principle, although it is the case that the foreign tax credit treats foreign income taxes more generously than other foreign taxes and business costs.

*“Clean coal” tax credit.* This is a tax credit of 20 percent for investment in integrated gasification combined cycle plants, and 15 percent for investment in other types of advanced coal technologies. This provision is a subsidy properly defined, and is efficient only if the related emissions regulations promulgated by the Environmental Protection Agency and by the states are inefficiently lax. Even in this latter case, the more appropriate course in principle might be a strengthening of that regulatory framework.

*Alternative fuels tax credit.* This tax credit of \$0.50 per gallon is a subsidy, and there is no obvious efficiency rationale that would justify it conceptually, as discussed in section IV.

*Production tax credit for “renewable” electricity production.* This tax credit is an obvious subsidy under a proper definition, and fails a reasonable economic efficiency test; moreover, the rationales usually offered as justifications for this tax preference are incorrect, as discussed in section IV.

*Investment tax credit for investments in other forms of “renewable” energy and electricity facilities.* The comments immediately above offered for the production tax credit are applicable here.

*Section 1603 grants in lieu of PTC or ITC tax credits for renewables.* The same comments apply.

*Residential energy-efficient property credit.* This provision is a subsidy properly defined, and is very likely to be inefficient unless property owners are confronted with energy prices not reflecting the true social cost of energy, and if other policy changes (e.g., a rationalization of local power rates) are not a lower-cost means of addressing that pricing problem.

*Tax credit for renewable and bio diesel fuels.* Again, this provision is a subsidy properly defined, and is very likely to be inefficient unless operators of the attendant vehicles are confronted with fuel prices not reflecting the true social cost of the fuels.

*Various “energy efficiency” credits and subventions and credits for plug-in electric and other alternative fuel vehicles.* These are obvious subsidies and are very likely to be inefficient.

### III. A Brief History of Modern U.S. Energy Subsidies

Congress passed and the president signed late last year the *Consolidated Appropriations Act, 2016*.<sup>7</sup> In the context of energy subsidies the legislation renewed production tax credits for wind and other power technologies retroactively to January 1, 2015, with new expiration dates and phaseouts varying by technology.<sup>8</sup> Investment tax credits were extended for solar, fuel cell, small wind, geothermal, microturbines, and co-generation (“combined heat and power”) projects, with gradual phaseouts of these tax subsidies between 2019 and 2022.<sup>9</sup> It borders on the implausible that this latest extension of such subsidies for uncompetitive electric power technologies will prove to be the last when the 2019-2022 Congressional sessions arrive, as a brief history of U.S. energy policy suggests strongly both in general and with respect to “renewable” and other unconventional energy sources in particular.<sup>10</sup>

In terms of the modern history of U.S. energy policy, we usefully can begin in the mid-1970s with the energy “crisis” and the perceived need to achieve an expansion of the supply and “independence” of U.S. energy production.<sup>11</sup> This original rationale has been expanded greatly over time, with environmental and “sustainability” arguments added to “energy independence”; but the early policy history begins with the dominant energy security concerns of that period. The 1978 *National Energy Act* (NEA) was focused for the most part on reducing dependence on foreign oil and on measures intended to increase conservation and efficiency in domestic energy consumption.<sup>12</sup>

As an aside, that overriding rationale was driven in substantial part by the perverse effects of the price and allocation controls imposed upon the energy sector during much of the

<sup>7</sup> See the text of the legislation at <https://www.gpo.gov/fdsys/pkg/BILLS-114hr2029enr/pdf/BILLS-114hr2029enr.pdf>.

<sup>8</sup> The expiration of the wind production tax credit was extended to December 31, 2019, with a phase-down imposed for wind projects beginning construction after the end of 2016. Tax credits for other eligible technologies (geothermal, biomass, and others) were extended for projects beginning construction before 2017. See the Department of Energy summary at <http://energy.gov/savings/renewable-electricity-production-tax-credit-ptc>.

<sup>9</sup> See the Department of Energy summary at <http://energy.gov/savings/business-energy-investment-tax-credit-itc>.

<sup>10</sup> With respect to the fundamental economic inefficiency of “renewable” and other such unconventional energy sources, see Benjamin Zycher, *Renewable Electricity Generation: Economic Analysis and Outlook*, Washington: AEI Press, November 15, 2011, at <http://www.aei.org/publication/renewable-electricity-generation/>. Such energy is “unconventional” precisely because it is uneconomic, and thus uncompetitive. See also Robert Bryce, “Energy Policies and Electricity Prices: Cautionary Tales from the E.U.,” monograph, Manhattan Institute, March 2016, at <http://www.manhattan-institute.org/sites/default/files/R-RB-0316.pdf>; and Robert Bryce, “What Happens to an Economy When Forced to Use Renewable Energy?,” Manhattan Institute Issue Brief, May 4, 2016, at <http://www.manhattan-institute.org/sites/default/files/IB-RB-0516.pdf>.

<sup>11</sup> Useful discussions and information are provided by the Energy Information Administration (EIA), “Policies to Promote Non-Hydro Renewable Energy in the United States and Selected Countries,” February 2005, at [http://nrec.mn/data/uploads/Nom%20setguul%20xicheel/PV/nonhydrorenewablespaper\\_final.pdf](http://nrec.mn/data/uploads/Nom%20setguul%20xicheel/PV/nonhydrorenewablespaper_final.pdf); Fredric Beck and Eric Martinot, “Renewable Energy Policies and Barriers,” *Encyclopedia of Energy*, Vol. 5 (2004), pp. 365-383; EIA, “Renewable Energy 2000: Issues and Trends,” February 2001, at <http://pbadupws.nrc.gov/docs/ML0932/ML093280377.pdf>; Eric Martinot, Ryan Wiser, and Jan Hamrin, “Renewable Energy Policies and Markets in the United States,” at [http://www.martinot.info/Martinot\\_et\\_al\\_CRS.pdf](http://www.martinot.info/Martinot_et_al_CRS.pdf); and North Carolina State University, North Carolina Clean Energy Technology Center, *Database of State Incentives for Renewables and Efficiency*, at <http://www.dsireusa.org/>.

<sup>12</sup> This legislation comprised five statutes: *The Energy Tax Act*, *The Natural Gas Policy Act*, *The National Energy Conservation Policy Act*, *The Power Plant and Industrial Fuel Use Act*, and *The Public Utility Regulatory Policies Act*.

1970s.<sup>13</sup> Market prices serve a number of economic functions, among them the imposition of discipline on consumption, and incentives for efficiency in the allocation of available supplies across competing uses. Such functions are crucial for achievement of the most productive use of supplies made more limited by supply disruptions, the central examples of which during the 1970s were the reduction in the output of crude oil by Arab OPEC during 1973-1975, and that caused by the Iranian revolution during 1978-1980.<sup>14</sup> Prices suppressed artificially by regulatory fiat can perform those central economic functions far less effectively, and in particular encourage consumption that is inefficient and total demands that exceed the supplies available, and a misallocation of those available supplies across competing uses.

And so subsidies for conservation and efficiency during that period in part represented an attempt to achieve by government fiat the market discipline and allocational outcomes suppressed by price and allocation regulations. But government incentives to achieve the same outcomes engendered by market prices are weak, and in any event government cannot achieve market-driven patterns of resource use because decisionmaking processes centralized by government cannot replicate the information revealed by market competition and market prices.<sup>15</sup> Instead, incentives for policymakers to use price and allocation regulation to bestow benefits upon favored constituencies are powerful. As an example, the allocation regulations imposed during the 1970s were based upon historical geographic consumption patterns; this meant that greater supplies than otherwise would have been the case went to rural areas, and lesser supplies to urban ones, an outcome that was predictable given the disproportionate political power enjoyed by less populated states in the U.S. Senate and in the electoral college, and because of the effects of gerrymandered congressional districts on the identity and policy preferences of the hypothetical median voter.<sup>16</sup>

The 1978 NEA included the *Public Utility Regulatory Policies Act*, intended ostensibly to increase conservation and efficiency in the electric utility sector. PURPA required electric utilities to purchase electricity from “qualifying facilities,” which were defined as electric power producers smaller than 80 MW (megawatts) in capacity using cogeneration processes or

<sup>13</sup> See Benjamin Zycher, “Emergency Management,” in S. Fred Singer, ed., *Free Market Energy: The Way to Benefit Consumers*, New York: Universe Books, 1984, pp. 74-98. See also Benjamin Zycher, “In Defense of Price Gouging and Profiteering,” *The American*, August 7, 2014, at <http://www.aei.org/publication/in-defense-of-price-gouging-and-profiteering/>.

<sup>14</sup> See Benjamin Zycher, “OPEC,” in David R. Henderson, ed., *The Concise Encyclopedia of Economics*, Indianapolis: Liberty Fund, 2008, at <http://www.econlib.org/library/Enc/OPEC.html>. See also the historical production data reported by BP in the *Statistical Review of World Energy 2015*, at <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>.

<sup>15</sup> See Zycher, 2014, *op. cit.*, fn. 10 *supra*.

<sup>16</sup> See Zycher, 1984, *loc. cit.*, fn. 13 *supra*. See also Aaron Wildavsky, *The Politics of the Budgetary Process*, Boston: Little, Brown, and Co., 1964, esp. pp. 102-108; Nelson W. Polsby, et. al., *Presidential Elections: Strategies and Structures of American Politics*, Lanham: Rowman & Littlefield, 2011, esp. ch. 2; Cary M. Atlas, et. al., “Slicing the Federal Government Net Spending Pie: Who Wins, Who Loses, and Why,” *American Economic Review*, Vol. 85, No. 3 (June 1995), pp. 624-629; Frances E. Lee, “Senate Representation and Coalition Building in Distributive Politics,” *American Political Science Review*, Vol. 94, Issue 1 (March 2000), pp. 59-72; George Rabinowitz and Stuart Elaine Macdonald, “The Power of the States in U.S. Presidential Elections,” *American Political Science Review*, Vol. 80, Issue 1 (March 1986), pp. 65-87; Benjamin Zycher, “The Electoral College Does It Better,” *Los Angeles Times*, October 27, 2004, at <http://articles.latimes.com/2004/oct/27/opinion/oe-zycher27>; and Gary C. Jacobson and Jamie L. Carson, *The Politics of Congressional Elections*, Lanham: Rowman & Littlefield, 2016, esp. pp. 246-252.

renewable technologies.<sup>17</sup> From an analytic standpoint, such purchase requirements are a tool with which to shift financing of renewables subsidies from the taxpayers writ large to the electricity market itself, as most state regulation of electricity prices bundles (or combines) lower- and higher-cost power into a single set of rates. This has the effect of subsidizing the producers of higher-cost power at the expense of consumers and the producers of lower-cost power. These implicit regulatory tax/expenditure transfers do not appear in government fiscal accounts. However, the very need for such implicit but sizeable subsidies, however financed, suggests, again, a fundamental competitiveness problem.

The 1978 NEA included also the *Energy Tax Act*, which gave an investment tax credit of 30 percent to residential consumers for solar and wind energy equipment, and a 10 percent investment tax credit to businesses installing solar, wind, geothermal, and ocean energy technologies. These tax credits ended in 1985.<sup>18</sup>

The 1992 *Energy Policy Act* created the production tax credit, set originally at 1.5 cents per kWh (kilowatt-hour) in 1993 dollars, adjusted for inflation, for some technologies, and 0.75 cents per kWh for others. The credit now is either 2.3 cents per kWh or 1.2 cents per kWh, respectively.<sup>19</sup> This credit has had a somewhat erratic history, having expired and been extended several times; the most recent extensions were in February 2009, January 2013, December 2014, and December 2015.<sup>20</sup>

A number of other federal policies encourage the use of renewable energy in electricity generation. Qualified investments are eligible for accelerated depreciation and bonus depreciation under the 2008 *Energy Improvement and Extension Act* (part of the Troubled Asset Relief Program),<sup>21</sup> the 2009 legislation just noted, and the 2010 *Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act*. Certain rebates for renewable energy offered

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<sup>17</sup> Cogeneration facilities, now more commonly called “combined heat and power” (CHP) facilities, produce electricity and then capture the resulting heat for heating purposes. Under PURPA, utilities were required to purchase this power at “avoided cost,” the determination of which was left to the state regulatory authorities; but the upshot is that under this requirement higher-cost power is “bundled” with lower-cost power in the determination of cost-based electricity rates. This has the effect of increasing the demand for the higher-cost power. The Federal Energy Regulatory Commission took over the determination of avoided cost in 1995.

<sup>18</sup> Wind technologies were practical for only very small numbers of residential and business consumers, and the same proved true for geothermal and ocean technologies.

<sup>19</sup> See fn. 8 and fn. 9, *supra*. The production tax credit is 2.3 cents per kWh for wind, closed-loop biomass, and geothermal generation; and 1.2 cents per kWh for open-loop biomass, landfill gas, municipal solid waste, qualified hydroelectric, and marine and hydrokinetic power.

<sup>20</sup> Respectively, the 2009 *American Recovery and Reinvestment Act*, the 2012 *American Taxpayer Relief Act*, the 2014 *Tax Increase Prevention Act*, and, as noted above, the *Consolidated Appropriations Act, 2016*. The 2009 legislation allowed facilities that qualify for the production tax credit to choose instead to take either the federal business energy investment credit or an equivalent cash grant. The latter two subsidies generally are 30 percent of eligible costs. Note that the investment tax credit/cash grant is based upon the capital cost of the renewable generation capacity, and thus is independent of the amount of electricity actually produced. With a few exceptions, facilities are eligible for the production tax credit for ten years. For an earlier discussion of ongoing problems with implementation of these programs, see *Memorandum for the President*, from Carol Browner, Ron Klain, and Larry Summers, “Renewable Energy Loan Guarantees and Grants,” October 25, 2010, at [http://www.politico.com/static/PPM182\\_101105\\_renewable\\_energy\\_memo.html](http://www.politico.com/static/PPM182_101105_renewable_energy_memo.html).

<sup>21</sup> See <http://thomas.loc.gov/cgi-bin/query/z?e110:H.R.1424.enr>. (Note: Colon correct as part of the hyperlink.)

consumers by electric utilities are excluded from taxable income. Several other grant, subsidy, and loan programs are administered by various federal agencies.<sup>22</sup>

Section IV offers summary critiques of the shifting policy rationales commonly asserted in favor of energy subsidies. Section V discusses in greater detail the newest “social cost of carbon” externality rationale for renewables subsidies, as estimated by an interagency working group of the Obama administration;<sup>23</sup> the attendant effects on temperatures in the year 2100 are discussed as a rough benefit/cost test. Finally, section VI offers some concluding observations.

#### IV. Observations on the Rationales for Energy Subsidies

As noted above, the policy rationales for energy subsidies have expanded over time. What has not changed is their rather poor analytic quality; not one is convincing, and the most prominent modern rationale---subsidies for renewable electricity (“clean energy”) as an adjunct of climate policy---is deeply flawed. The central arguments for energy subsidies can be categorized as follows; the social cost of carbon argument is addressed in section V.

- Energy “independence.”
- Support for infant industries.
- Leveling the subsidy playing field.
- Adverse external effects of conventional generation.
- Resource depletion or “sustainability.”
- Employment expansion through “green jobs.”
- The “social cost of carbon.”

Energy “Independence.” It still is asserted commonly that it was the 1973 Arab OPEC oil “embargo” that created the sharp price increases in 1973 and 1979, and the market dislocations experienced in the U.S. during that decade.<sup>24</sup> In the wake of the 1970s experience, many have argued that explicit and implicit subsidies for domestic energy production would increase energy “independence” and thus insulate the U.S. economy from the effects of international supply disruptions.<sup>25</sup>

Those arguments were and remain largely incorrect. Since there can be only one world market for crude oil, a refusal to sell to a given buyer (i.e., impose a higher price on that buyer only) cannot work, as market forces will reallocate oil so that prices are equal everywhere

<sup>22</sup> Examples include renewable energy grants from the Treasury Department, various grant and loan guarantee programs from the Agriculture Department, and loan guarantee programs from the Energy Department. See North Carolina State University, *op. cit.*, fn. 11 *supra*.

<sup>23</sup> See “Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,” Interagency Working Group on Social Cost of Carbon, revised July 2015, at <https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf>.

<sup>24</sup> See, e.g., Greg Myre, “The 1973 Arab Oil Embargo: The Old Rules No Longer Apply,” NPR Parallels, October 16, 2013, at <http://www.npr.org/sections/parallels/2013/10/15/234771573/the-1973-arab-oil-embargo-the-old-rules-no-longer-apply>.

<sup>25</sup> See, e.g., the discussion of “Energy Security” presented by the Renewable Fuels Association at <http://www.ethanolrfa.org/issues/energy-security/>.

(adjusting for such minor complications as differential transport costs). The 1973 embargo aimed at the U.S., the Netherlands, and a few others had no effect at all: All the targeted nations obtained oil on the same terms as all other buyers, although the transport directions of the global oil trade changed because of the reallocation process. It was the production cutback by Arab OPEC that raised international prices; and it was the U.S. system of price and allocation controls that created the queues and other market distortions. Note that there was no embargo in 1979, but there was a production cutback in the wake of the Iranian revolution, and the U.S. again imposed price and allocation regulations. And, once again, there were queues and market distortions.<sup>26</sup>

Furthermore, however counterintuitive it may seem, the degree of “dependence” on foreign sources of energy is irrelevant, except in the case in which a foreign supplier or foreign power can impose a physical supply restriction, perhaps through a naval blockade or a military threat to ocean transport through, say, a narrow strait. Russian pipeline delivery of natural gas to Europe is a related example. But in the general case, because the market for crude oil is international in nature, as noted above, nations that import all of their oil face the same prices as those that import none of their oil. The cases of Japan and the UK, respectively, illustrate this point nicely: Changes in international prices, caused perhaps by supply disruptions, yield price changes in the two classes of economies that are equal, except for such minor factors as differences in exchange-rate effects and the like. Accordingly, the degree of energy “dependence” is irrelevant, the quest for energy “independence” is guaranteed to impose costs without offsetting benefits, and policy tools intended to increase such “independence” should be abandoned.

As an aside, many observers and commentators on the international oil market often refer to pricing and production behavior by “the OPEC cartel,” but that characterization is not correct.<sup>27</sup> OPEC has never behaved like a cartel in the classic sense of allocating production shares so as to equate marginal production cost across producers. It is Saudi production that historically has determined world market prices simply because Saudi production and reserves have been so large. It is more useful analytically to view OPEC as one big producer determining the market price, and a number of smaller ones who accept that price and then try to find ways to erode it so as to garner bigger market shares for themselves. An example of such price shaving is an extension of credit for buyers beyond the usual thirty days. Games can be played also with the qualities of oil delivered, and with a number of other parameters.<sup>28</sup>

*The Infant Industry Argument.* Many argue that new technologies---wind and solar power are good examples---often cannot compete with established ones because the available market at the beginning is too small for important scale economies to be exploited, and because the downward shifts in costs that might result from a learning process cannot be achieved without substantial expansion in capacity and production. Accordingly, policy support for

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<sup>26</sup> See Zycher, 1984, *loc. cit.*, fn. 13 *supra*.

<sup>27</sup> See, e.g., Daniel Yergin, *The Prize: The Epic Quest for Oil, Money, and Power*, New York: Free Press, 1992, esp. pp. 718-724.

<sup>28</sup> See Zycher, *op. cit.*, fn. 14 *supra*; and the Saudi historical production data for crude oil at <https://www.eia.gov/forecasts/steo/tables/?tableNumber=7#startcode=1997>.

expansion of the newcomers' share of the market is justified as a tool with which to allow the achievement of both scale and learning efficiencies.

The central problem with this argument is that the market for electric power already has several competing technologies, each of which began with a small market share virtually by definition. More generally, many industries employing competing technologies are characterized by the presence of scale economies and/or learning efficiencies; but market forces operating through domestic and international capital markets provide investment capital in anticipation of future cost savings and higher economic returns. Accordingly, the infant industry argument is a *non sequitur*: The market can foresee the potential for scale and learning efficiencies, and invest accordingly. This argument provides no efficiency rationale for subsidies or other policy support.<sup>29</sup>

Leveling the Subsidy Playing Field. Another central argument made in favor of policy support for renewables is essentially a level-playing-field premise: Because conventional generation ostensibly benefits from important tax preferences and other policy support, renewables cannot compete without similar treatment. A recent EIA analysis presents data from which federal subsidies and support for a range of different energy types can be compared.<sup>30</sup> These data are presented in Table 1.<sup>31</sup>

Table 1  
FY2013 Electricity and Non-Electricity Subsidies: Direct Outlays and Tax Expenditures  
(year 2013 dollars)

Fuel/Technology	Electricity per mWh		Non-Electricity per quadrillion btu	
	Outlays	Tax Exp	Outlays	Tax Exp
Natural Gas,				
Petroleum Liquids	0.02	0.58	1.24	45.11
Coal (pulverized)	0.04	0.41	4.59	48.27
Hydroelectric	0.72	0.06	92.06	7.94
Biomass	1.03	0.15	492.70	68.27
Nuclear	0.05	1.41	n.a.	n.a.
Geothermal	13.00	1.29	1516.03	150.63
Wind	25.44	9.61	n.a.	n.a.

<sup>29</sup> For a discussion of the data on scale and learning efficiencies for renewable electricity, see Zycher, *op. cit.*, fn. 10 *supra*.

<sup>30</sup> See U.S. Energy Information Administration, "Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2013," March 2015, at <http://www.eia.gov/analysis/requests/subsidy/pdf/subsidy.pdf>.

<sup>31</sup> Other things held constant, subsidies that affect the marginal (or incremental) cost of generation or the per-unit prices received by particular technologies are likely to affect market prices, even under standard rate-of-return regulation, and so might create a competitive disadvantage for other technologies not receiving equivalent treatment. An example is the per-unit production tax credit for renewable power. Other credits might improve profitability without affecting marginal costs or prices directly; investment tax credits for renewables are a good example. The latter would attract additional investment into the industry over time, thus perhaps affecting market prices, but that price effect would be felt by all producers regardless of which actually received the subsidy. At the same time, even such subsidies as the latter would serve to reduce or eliminate whatever competitive disadvantages confront renewables as a result of policies that purportedly support conventional generation.

Solar	128.84	90.11	2501.14	1748.86
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Source: Energy Information Administration, *op. cit.*, fn. 24 *supra*; and author computations. Computation of direct subsidies and tax expenditures for fuels used outside electric power sector assumes same proportions as for total subsidies.  
n.a.: not applicable.

With respect to energy sources used for electric generation, these data show that federal subsidies and financial support, whether in the form of outlays or tax expenditures, are vastly higher for renewables than for conventional fuels used in power production, on a per-mWh basis. This reality holds *a fortiori* for wind and solar power, for which federal financial support was higher than that for fossil fuels by approximate factors of sixteen to sixty-four hundred. The same pattern holds for fuels used outside the power sector; on a per-btu basis, biomass, geothermal, and solar subsidies exceed those for conventional fuels by approximate factors ranging up to two thousand. Accordingly, it is clear that renewable power technologies are not at a competitive disadvantage because of average federal subsidy outlays and tax expenditures received by conventional generation; quite the reverse is true.<sup>32</sup>

A somewhat older calculation of marginal subsidies and support through tax expenditures has been reported by Metcalf, yielding estimates of effective marginal tax rates on investments in alternative electric generation technologies. Computation of such effective marginal tax rates incorporates the many subsidies and preferences that affect choices among those alternatives, and so offers a direct test of the degree to which federal tax expenditures favor given technologies over others.<sup>33</sup> Table 2 summarizes his findings, which are for 2007.

Table 2  
Metcalf Findings on Effective Marginal Tax Rates For Electric Generation Investment  
(percent)

Technology	Current Law	No Tax Credits	Economic Depreciation
Coal (pulverized)	38.9	38.9	39.3
Gas	34.4	34.4	39.3
Nuclear	-99.5	32.4	-49.4

<sup>32</sup> This is only part of the "subsidy" issue: We should examine also the relative subsidies or tax expenditures net of royalty and other such payments made to the federal government as compensation for the use of federal land. I have made that computation for the Ivanpah thermal solar power facility in California; per million btu of energy produced, Ivanpah pays \$0.88 while oil and gas producers pay \$1.23. See Benjamin Zycher, "California's New Solar Plant: Burning Up Taxpayer Money, Land, and Wildlife," *The American*, May 21, 2014, at <http://www.aei.org/publication/californias-new-solar-plant-burning-up-taxpayer-money-land-and-wildlife/>.

<sup>33</sup> See Gilbert E. Metcalf, "Investment in Energy Infrastructure and the Tax Code," in Jeffrey R. Brown, ed., *Tax Policy and the Economy*, Volume 24, Chicago: University of Chicago Press Journals, 2010, pp. 1-33. See also Gilbert E. Metcalf, "Federal Tax Policy Towards Energy," NBER Working Paper No. 12568, October 2006, at <http://www.nber.org/papers/w12568.pdf>; and Gilbert E. Metcalf, "Taxing Energy In the United States: Which Fuels Does the Tax Code Favor?," Manhattan Institute Center for Energy Policy and the Environment, Report No. 4, January 2009, at [http://www.manhattan-institute.org/html/eper\\_04.htm](http://www.manhattan-institute.org/html/eper_04.htm).

Solar Thermal	-244.7	12.8	-26.5
Wind	-163.8	12.8	-13.7

Source: Metcalf (2010), *op. cit.*, fn. 33, *supra*.  
 Note: Current law is as of 2007.

The three columns present the Metcalf calculations of effective marginal tax rates under 2007 law, under a regime without production and investment tax credits, and with economic depreciation assumed in place of accelerated depreciation, respectively.<sup>34</sup> Under 2007 law, solar thermal and wind generation investments received large net percentage marginal tax-expenditure subsidies (negative effective marginal tax rates) far larger than those enjoyed by nuclear investments; and coal and gas investments faced effective tax rates greater than zero. If the tax credits are assumed away, solar thermal and wind investments faced effective tax rates roughly one-third those of the other technologies. If economic depreciation replaces accelerated depreciation, nuclear investment enjoyed a negative effective marginal tax rate (tax subsidy) larger (in absolute value) than those for solar and wind investments; but coal and gas investments faced effective marginal tax rates of over 39 percent.

The Metcalf calculations of effective marginal tax rates under 2007 law suggest strongly that the “offsetting subsidy” rationale for federal financial support of solar and wind investments is weak: Coal and gas investments face positive effective marginal tax rates, and new nuclear investment does not seem to be a serious competitive threat over the medium term.<sup>35</sup> Moreover, the effective subsidies enjoyed by solar and wind generation are far greater than those needed to level the playing field with respect to nuclear generation except under Metcalf’s “economic depreciation” assumption.<sup>36</sup>

*Adverse External Effects of Conventional Generation.* A negative “externality” is an adverse effect of economic activity the full costs of which are not borne by the parties engaging directly in the activity yielding the adverse effect. A simple example is the emission of effluents into the air as a byproduct of such industrial processes as power generation. There is no dispute

<sup>34</sup> Metcalf uses an exponential depreciation rate rather than straight-line depreciation as an approximation of economic depreciation over the lives of given investments.

<sup>35</sup> The last nuclear generation reactor to begin commercial operation is the Watts Bar-2 plant in Tennessee, on October 19, 2016. See EIA at <https://www.eia.gov/tools/faqs/faq.cfm?id=228&t=21>.

<sup>36</sup> The playing field is biased in favor of renewables for two additional reasons, the first of which is the implicit subsidy for backup generation capacity and transmission costs: Such costs are a direct effect of investment in renewable capacity, but are spread across electricity consumption from all sources. The Federal Energy Regulatory Commission, in a recent case involving the Midwest Independent Transmission Operator, ruled that the transmission costs attributable to wind generation may be allocated to consumers regardless of the amount of wind power actually consumed by any given ratepayer. This ruling essentially spreads such costs across the entire grid; accordingly, the transmission costs attendant specifically upon wind generation are not reduced but instead are hidden somewhat from calculations of the marginal cost of wind power. See the FERC Conditional Order, Docket No. ER10-1791-000, December 16, 2010, at <http://www.ferc.gov/whats-new/comm-meet/2010/121610/E-1.pdf>. Second, public subsidies for renewable power, whether in the form of direct outlays or indirect tax preferences, impose costs upon the private sector larger than the subsidies themselves, because of the excess burden (or “deadweight losses”) imposed by the tax system. Essentially, the private sector becomes smaller by more than a dollar when it is forced to send a dollar to the federal government. For a nontechnical discussion, see Martin A. Feldstein, “The Effect of Taxes on Efficiency and Growth,” *Tax Notes*, May 8, 2006, pp. 679-684.

that power generation with fossil fuels imposes adverse environmental effects due to the emission of carbon monoxide, sulfur oxides, nitrogen oxides, mercury, particulates, lead, and other effluents. Accordingly, the EPA and the states have established detailed programs for defining emission standards and for implementing attendant investment and enforcement programs.

If the negative externalities yielded by conventional generation are not internalized fully by current environmental policies---that is, if buyers and producers are not confronted with the full costs of the adverse environmental effects that they impose on others---then the costs of conventional generation as perceived by the market would be (artificially) lower than the true social costs. At the same time, the unreliable nature of wind and solar generation imposes a requirement for costly backup capacity. And so the question to be addressed is as follows: Given the magnitude of those backup cost requirements---which are economic externalities imposed by renewables---as estimated in the technical literature, are the additional (or marginal) costs of backup capacity imposed by renewable generation sufficient to offset any artificial "externality" cost advantage enjoyed by conventional generation?<sup>37</sup>

A number of analyses of the environmental externality costs of U.S. electricity generation were conducted during the 1980s and 1990s.<sup>38</sup> These studies differ somewhat in terms of methodology and focus, but offer a range of estimates useful in terms of the question addressed here. In summary: The estimated externality costs for coal range from 0.1 cents to 26.5 cents per kWh. For gas generation, the range is 0.1-10.2 cents per kWh. For oil, nuclear, and hydro generation, the respective ranges are 0.4-16.5 cents per kWh, 0-4.9 cents per kWh, and 0-2.1 cents per kWh.

The highest estimated figure for coal generation is 26.5 cents per kWh, or \$265 per mWh. A conservative estimate of the cost of backup capacity for existing wind and solar generation is about \$368 per mWh, or roughly 37 cents per kWh.<sup>39</sup> Accordingly, if all conventional generation were coal-fired, existing wind and solar capacity imposes a backup cost "externality"

<sup>37</sup> Note that because renewable generation---wind and solar power---are unreliable, the conventional backup generation must be cycled up and down in coordination with the availability of the renewable generation. In particular for coal-fired generation, but also for gas combined-cycle backup generation, this means that the conventional assets cannot be operated as efficiently as would be the case were they not cycled up and down in response to wind or solar generation conditions. Inefficient operation---a higher heat rate, that is, more btu of energy input per mWh generated---is the necessary result of such cycling. A recent study of the attendant emissions effects for Colorado and Texas found that requirements for the use of wind power impose significant operating and capital costs because of cycling needs for backup generation---particularly coal plants---and actually exacerbate air pollution problems. See Bentek Energy LLC, *How Less Became More: Wind, Power and Unintended Consequences in the Colorado Energy Market*, April 16, 2010, at <http://docs.wind-watch.org/BENTEK-How-Less-Became-More.pdf>.

<sup>38</sup> For a detailed discussion of that literature, see Zycher, *op. cit.*, fn. 10 *supra.*, at 41-46. Note that renewable power generation imposes its own set of problems, including noise, light flicker effects, deaths among possibly-large numbers of birds, pollution with heavy metals, consumption of large amounts of land with unsightly turbine farms or solar collection panels, and others. See Zycher, *op. cit.*, fn. 32 *supra.* Interestingly, new research finds that large-scale adoption of wind generation might cause an increase in surface temperatures. See C. Wang and R.G. Prinn, "Potential Climatic Impacts and Reliability of Very Large-Scale Wind Farms," *Atmospheric Chemistry and Physics*, Vol. 10, No. 4 (2010), pp. 2052-2061, at <http://www.atmos-chem-phys.net/10/2053/2010/acp-10-2053-2010.pdf>.

<sup>39</sup> See Zycher, *op. cit.*, fn. 10 *supra.*, at 26-31.

about 39 percent higher than the environmental externality costs of conventional generation under the implausible assumption that none of the conventional externalities have been internalized under current environmental policies.

But in fact coal generation is about 33 percent of total U.S. generation; gas generation is about 33 percent, nuclear generation is about 20 percent, hydroelectric generation is about 6 percent, and renewables and other miscellaneous technologies make up the rest.<sup>40</sup> If we use those figures and the highest estimates by fuel type noted above to compute a weighted-average externality cost for nonrenewable generation, the externality cost per conventional kWh is about 13.2 cents, or \$132 per mWh. Relative to the backup cost “externality” (\$368 per mWh) imposed by wind and solar investments alone, those figures are sufficiently low to cast substantial doubt upon the externality argument for tax expenditures on renewables: Current environmental regulation must internalize some substantial part of conventional externalities, and federal and state subsidies, both explicit and implicit, and requirements for minimum market shares for renewables also have the effect of offsetting any artificial cost advantage enjoyed by conventional generation as a result of uninternalized externalities.

The environmental problems caused by renewable power are substantial---noise, flicker effects, wildlife destruction, heavy-metals pollution, unsightly land use, etc.---but represent a topic outside the scope of the discussion here.<sup>41</sup> In any event, note that in terms of economic efficiency, subsidies in the form of direct outlays or tax expenditures for renewables intended to offset the (assumed) uninternalized external costs of conventional generation are a “second-best” policy at best. Such subsidies would reduce the (inefficient) competitive advantage of conventional generation yielded by the presence of some social costs not reflected in prices; but they would not improve the efficiency of costs or prices for conventional generation. And by biasing the perceived costs and prices of renewable generation downward, the subsidies would result in a total electricity market that would be too large. In short: The externality argument in favor of tax expenditures or policy support for renewable electricity generation is exceedingly weak, far more so than commonly assumed.

*The Resource Depletion or “Sustainability” Argument.* “Renewable” energy has no uniform definition; but the (assumed) finite physical quantity of such conventional energy sources as petroleum is the essential characteristic differentiating the two in most discussions.<sup>42</sup> In a word, conventional energy sources physically are (assumed to be) depletable; but that would not yield a depletion problem as an economic reality under market processes, as discussed below. In contrast, each sunrise and geographic temperature differential yields new supplies of sunlight and wind flows, a central component of “sustainability,” which perhaps is a concept broader than

<sup>40</sup> See the EIA data at [https://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.cfm?t=epmt\\_1\\_1](https://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_1) and at <https://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3>.

<sup>41</sup> See fn. 38 *supra*.

<sup>42</sup> There is considerable discussion in the technical literature of non-biological sources of methane and petroleum. See James A. Kent, *Kent and Riegel's Handbook of Industrial Chemistry and Biotechnology*, 11<sup>th</sup> ed., New York: Springer, 2007, Ch. 20; and M. Ragheb, “Biogenic and Abiogenic Petroleum,” at <http://mragheb.com/NPRE%20402%20ME%20405%20Nuclear%20Power%20Engineering/Biogenic%20and%20Abiogenic%20Petroleum.pdf>. To the extent that conventional energy resources are produced non-biologically, the “depletion” assumption underlying the sustainability argument may be incorrect even descriptively.

the depletion condition. Nonetheless, the definition of “sustainability” is highly elusive, as the Environmental Protection Agency discussion illustrates:

Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. To pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations.<sup>43</sup>

This obviously is infantile blather, definitive proof that the EPA has no idea what “sustainability” means as an analytic concept. An international definition often cited is that from the *Report of the World Commission on Environment and Development: Our Common Future*:

Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.<sup>44</sup>

This definition also is useless, as “needs” whether present or future are undefined, the evaluation of the inexorable tradeoffs among such needs is ignored, again whether in the present or the future or across time periods and generations, the effects of unknown but certain technological advances are not considered, *ad infinitum*.

In any event, the energy content of sunlight and wind is finite, regardless of whether new supplies of sunlight or wind flows emerge continually. They contain only so much convertible energy, which is not always available. Moreover, the same is true for the other resources---materials, land, etc.---upon which the conversion of such renewable energy into electricity depends. More fundamentally, the basic “sustainability” concept seems to be that without policy intervention, market forces will result in the depletion (or exhaustion) of a finite resource. Accordingly, subsidies and other support for renewable power generation are justified as tools with which to slow such depletion and to hasten the development of technologies that would provide alternatives for future generations.

That argument is deeply problematic. Putting aside the issue of whether government as an institution has incentives to adopt a time horizon longer than that relevant for the private sector, the profit motive provides incentives for the market to consider the long-run effects of current decisions. The market rate of interest is a price that links the interests of generations present and future. If a resource is being depleted, then its expected future price will rise, other things held constant. If that rate of price increase is greater than the market interest rate, then owners of the resource have incentives to reduce production today---by doing so they can sell the resource in the future and in effect earn a rate of return higher than the market rate of interest---thus raising prices today and reducing expected future prices. In equilibrium---again, other

<sup>43</sup> See the EPA discussion at <https://www.epa.gov/sustainability/learn-about-sustainability#what>.

<sup>44</sup> See <http://www.un-documents.net/our-common-future.pdf>.

factors held constant--expected prices should rise at the market rate of interest.<sup>45</sup> Under market institutions, it is the market rate of interest, again, that ties the interests of the current and future generations by making it profitable currently to conserve some considerable volume of exhaustible resources for future consumption.<sup>46</sup> Because of the market rate of interest, market forces will never allow the depletion of a given resource.

Accordingly, the market has powerful incentives to conserve, that is, to shift the consumption of large volumes of finite (or depletable) resources into future periods. That is why, for example, not all crude oil was used up decades ago even though the market price of crude oil always was greater than zero, which is to say that using it would have yielded value. In short, the "sustainability" argument for policy support for renewable electricity depends crucially upon an assumption that the market conserves too little and that government has incentives to improve the allocation of exhaustible resources over time. That is a dual premise for which the underlying rationale is weak and with respect to which little persuasive evidence has been presented.<sup>47</sup>

*"Green Jobs": Renewable Power As A Source of Expanded Employment.* A common argument in support of expanded renewable power posits that policies (subsidies) in support of that goal will yield important benefits in the form of complementary employment growth in renewables sectors, and stronger demand in the labor market in the aggregate. Both of those premises are almost certainly incorrect.

The employment in renewables sectors created by renewables policies actually would be an economic cost rather than a benefit for the economy as a whole. Suppose that policy support for renewables (or for any other sector) were to have the effect of increasing the demand for, say, high-quality steel. That clearly would be a benefit for steel producers, or more broadly, for owners of inputs in steel production, including steel workers. But for the economy as a whole, the need for additional high-quality steel in an expanding renewable power sector would be an economic cost, as that steel (or the resources used to produce it) would not be available for use in other sectors. Similarly, the creation of "green jobs" as a side effect of renewables policies is a benefit for the workers hired (or for those whose wages rise with increased market competition for their services). But for the economy as whole, that use of scarce labor is a cost because those workers no longer would be available for productive activity elsewhere.<sup>48</sup>

<sup>45</sup> In reality the long run prices of most exhaustible natural resources have declined (after adjusting for inflation), in large part because of (unexpected) technological advances in discovery, production, and use.

<sup>46</sup> Strictly speaking, it is not the price of the resource that should rise at the market rate of interest; instead the total economic return to holding the resource for future use should equal the market rate of interest. That total economic return includes expected price changes and capital gains, expected cost savings, and the like. Current and expected prices are a reasonable first approximation of that total economic return.

<sup>47</sup> For a more detailed conceptual and empirical discussion of the market allocation of a depletable resource over time, see Benjamin Zycher, "World Oil Prices: Market Expectations, the House of Saud, and the Transient Effects of Supply Disruptions," monograph, *aei.org*, June 2016, at <http://www.aei.org/wp-content/uploads/2016/06/World-Oil-Prices.pdf>.

<sup>48</sup> Considerable employment would be created if policies encouraged ditch-digging with shovels (or, in Milton Friedman's famous example, spoons) rather than heavy equipment. Such employment obviously would be laughable, that is, an obvious economic burden. There is no analytic difference between this example and the "green jobs" rationale for renewables subsidies.

More to the point, an expansion of the renewable electricity sector must mean a decline in some other sector(s), with an attendant reduction in resource use there; after all resources in the aggregate are finite. If there exists substantial unemployment, and if labor demand in renewables is not highly specialized, a short-run increase in total employment might result. But in the long run---not necessarily a long period of time---such industrial policies cannot “create” employment; they can only shift it among economic sectors. In short, an expanding renewables sector must be accompanied by a decline in other sectors, whether relative or absolute, and creation of “green jobs” must be accompanied by a destruction of jobs elsewhere. Even if an expanding renewables sector is more labor-intensive (per unit of output) than the sectors that would decline as a result, it remains the case that the employment expansion would be a cost for the economy as a whole, and the aggregate result would be an economy smaller than otherwise would be the case.<sup>49</sup> There is no particular reason to believe that the employment gained as a result of the (hypothetically) greater labor intensiveness of renewables systematically would be greater than the employment lost because of the decline of other sectors, combined with the adverse employment effect of the smaller economy in the aggregate. There is in addition the adverse employment effect of the explicit or implicit taxes that must be imposed to finance the expansion of renewable power.

Because renewable electricity generation is more costly than conventional generation, policies driving a shift toward heavier reliance upon the former would increase aggregate electricity costs, and thus reduce electricity use below levels that would prevail otherwise.<sup>50</sup> The 2007 EIA projection of total U.S. electricity consumption in 2030 was about 5.17 million gigawatt-hours (gWh).<sup>51</sup> The latest EIA projection for 2030 is about 4.44 million gWh, a decline of about 14 percent.<sup>52</sup> The change presumably reflects some combination of assumptions about structural economic shifts, increased conservation, substitution of renewables for some conventional generation, and a projected price increase (in 2015 dollars) from about 9.3 cents per kWh to 11.6 cents, or almost 25 percent.<sup>53</sup> Because, in the EIA projections, consumption of electric power in 2030 falls by that 14 percent between the 2007 and 2015 analyses, the projected price increase is likely to be due to increases in costs rather than strengthened demand conditions.

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<sup>49</sup> Many advocates of renewables subsidies assert that solar and wind power is more labor intensive than conventional generation. The assumption of greater labor intensity for renewable power production is dubious: The operation of solar or wind facilities does not employ large amounts of labor, and it is far from clear that construction of solar or wind facilities is more labor intensive than construction of conventional generation facilities.

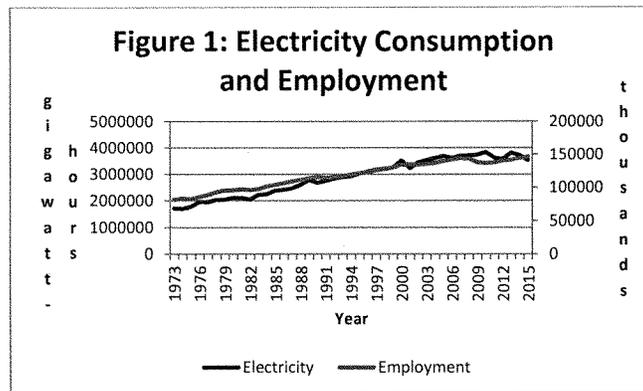
<sup>50</sup> See Zycher, *op. cit.*, fn. 10 *supra*.

<sup>51</sup> See EIA at [http://www.eia.doe.gov/oiaf/archive/aec07/aecoref\\_tab.html](http://www.eia.doe.gov/oiaf/archive/aec07/aecoref_tab.html), at Table 2.

<sup>52</sup> See EIA at <http://www.eia.gov/forecasts/aec/pdf/tbla8.pdf>.

<sup>53</sup> The EIA 2007 price projection for electricity in 2030 was \$23.60 per million btu in year 2005 dollars, or about 8.1 cents per kWh at a conversion rate of 293 kWh per million btu (3413 btu per kWh); that is about 9.3 cents in year 2015 dollars. See EIA at [http://www.eia.gov/oiaf/archive/aec07/pdf/aecotab\\_3.pdf](http://www.eia.gov/oiaf/archive/aec07/pdf/aecotab_3.pdf). The EIA projection in 2015 for 2030 was \$33.97 per million btu, or 11.6 cents per kWh, in year 2015 dollars. See EIA at <http://www.eia.gov/forecasts/aec/data.cfm#summary> (Table 3). The deflators are derived from the Council of Economic Advisers, *Annual Report of the Council of Economic Advisers*, February 2016, Table B-3, at <https://www.whitehouse.gov/administration/eop/cea/economic-report-of-the-President/2016>.

Accordingly, it would be surprising if that reduction in total U.S. electricity consumption failed to have some nontrivial employment effect. Figure 1 displays data on electricity consumption, and non-agricultural employment for the period 1973 through 2015.<sup>54</sup>



It is obvious from the aggregate trends that electricity use and labor employment are complements rather than substitutes; the simple correlation between the two series is 0.988, meaning, crudely, that a one-unit change in one tends to be observed with a 0.988 unit change in the other, in the same direction.

Correlation is not causation; but it is not plausible that an increase in electricity costs (or energy costs more broadly) would fail to have adverse effects on employment, if only by increasing the cost of using equipment and other such capital complementary with labor employment.<sup>55</sup> The determination (or refutation) of such economic relationships would require application (and statistical testing) of a conceptual model, a task outside the scope of the issues addressed here. But the data displayed in Figure 1 provide strong grounds to infer that the higher costs and reduced electricity consumption attendant upon expansion of renewable generation would reduce employment; at a minimum they provide strong grounds to question the common assertion that policies in support of expanded renewable electricity generation would yield

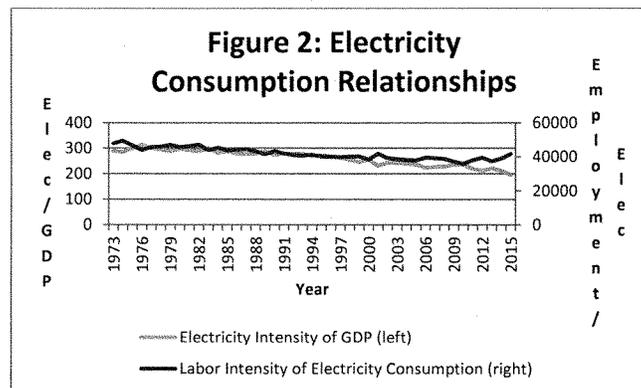
<sup>54</sup> For civilian employment, see the Bureau of Labor Statistics at <http://www.bls.gov/cps/tables.htm>. For electricity consumption, see EIA at <http://www.eia.gov/totalenergy/data/annual/index.cfm#electricity> (Table 8.9).

<sup>55</sup> It is important to keep clear the conceptual experiment under consideration. In the context here, we assume that government policies increase the substitution of renewable power in place of conventional electricity, and ask whether the aggregate data are consistent with the assertion that such "green" policies---explicitly an increase in energy costs (see Zycher, *op. cit.*, fn. 10 *supra*)---can be predicted to yield an increase in aggregate employment. This is very different from, say, the effects of an aggregate recession, which can be predicted to reduce both energy costs (prices) and employment more-or-less simultaneously. Similarly, an economic boom would increase both energy prices and employment, while an increase in energy supplies would reduce energy prices and increase employment. Note that aggregate employment in any of these scenarios might fall in the short run as market forces reallocate labor (and other resources) in response to changes in relative prices.

increases in aggregate employment as a side effect, putting aside whether such increases would be a net economic benefit for the economy as a whole.

It certainly is possible that the historical relationship between employment and electricity consumption will change. Technological advances are certain to occur; but the prospective nature and effects of those shifts are difficult to predict.<sup>56</sup> The U.S. economy may evolve over time in ways yielding important changes in the relative sizes of industries and sectors, as it has continually over time; but, again, the direction of the attendant shifts in employment and electricity use is ambiguous.

But there exists no evidence with which to predict that a reduction in electricity consumption would yield an increase in employment. Like all geographic entities, the U.S. has certain long-term characteristics---climate, available resources, geographic location, trading partners, legal institutions, *ad infinitum*---that determine in substantial part the long-run comparative advantages of the economy in terms of economic activities and specialization. Figure 2 presents the historical paths of the electricity intensity of U.S. GDP (electricity consumption per dollar of output) and of the labor intensity of U.S. electricity consumption (employment per million gWh of power consumption).<sup>57</sup>



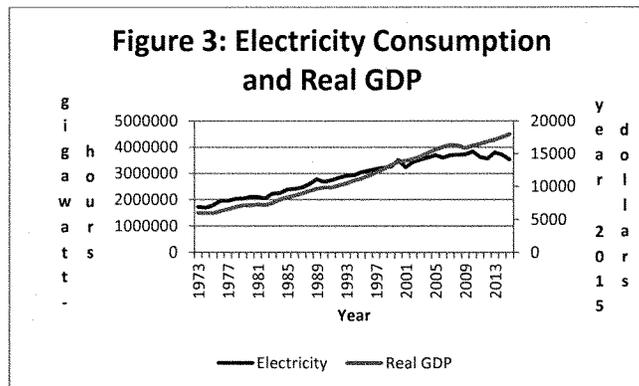
<sup>56</sup> Note that greater energy "efficiency" in any given activity can yield an increase in actual energy consumption, if the elasticity of energy demand with respect to the marginal cost of energy use is greater than one. If, for example, air conditioning were to become sufficiently "efficient" in terms of energy consumption per degree of cooling, it is possible that air conditioners would be run so much---or that so many additional air conditioners would be installed---that total energy consumption in space cooling would increase. A tax, on the other hand, whether explicit or implicit, increases the price of energy use, and so unambiguously reduces energy consumption.

<sup>57</sup> Sources: See BLS and EIA, *op. cit.* fn. 54 *supra.*; and for GDP, Bureau of Economic Analysis at <http://www.bea.gov/national/index.htm#gdp>, Federal Reserve Bank of St. Louis at <https://research.stlouisfed.org/fred2/series/GDPDEF>, and author computations.

During 1973-2015, the electricity intensity of GDP has increased and declined over various years, but for the whole period has declined slightly at a compound annual rate of about 0.9 percent. The labor intensity of U.S. electricity consumption---in a sense, the employment “supported” by each increment of electricity consumption---has declined over the entire period at an annual compound rate of about 0.3 percent. This may be the result largely of changes in the composition of U.S. GDP (toward services), and perhaps the substantial increase in U.S. labor productivity in manufacturing.

But these data are not consistent with the premise that a reduction in electricity consumption driven by an increase in energy costs would yield an increase in aggregate employment; instead, they suggest the reverse strongly. In short, while the electricity/output and employment/electricity relationships may have declined over time, there is no evidence that they are unimportant in an absolute sense, and they are far from negative. An increase in the cost of electric power will reduce electricity consumption and employment, notwithstanding ubiquitous assertions about the “green jobs” attendant upon an expansion of wind and solar power.

Finally, Figure 3 presents the crude relationship between electricity consumption and real GDP; the simple correlation between these two parameters is 0.977 for 1973-2015. This relationship makes it difficult to believe that an artificial increase in electricity costs would fail to erode GDP growth and thus employment.



### III. The “Social Cost of Carbon” Rationale for Renewables Subsidies

The newest application of the externality rationale is the “social cost of carbon” (SCC) analysis conducted by an interagency working group of the Obama Administration.<sup>58</sup> The

<sup>58</sup> See *op. cit.*, fn. 23, *supra*.

overall purpose of this estimate of the SCC was the application of benefit/cost analysis to policies proposed to mitigate the asserted effects of increasing atmospheric concentrations of greenhouse gases (GHG), that is, “climate” policies. The SCC analysis is deeply flawed, for three central reasons: the use of “global” benefits in the benefit/cost calculation, the failure to apply a 7 percent discount rate to the stream of (asserted) future benefits and costs, and the use of ozone and particulate reductions as “co-benefits” of climate policies.<sup>59</sup>

Before turning to those analytic issues, it is important to note as an aside that carbon dioxide---the most important anthropogenic GHG---is not “carbon.” “Carbon” is soot, or in the language of environmental policy, particulates; carbon dioxide is a colorless, odorless GHG, a certain minimum atmospheric concentration of which is necessary for life itself. It is, therefore, not a “pollutant.” By far the most important GHG in terms of the radiative properties of the troposphere is water vapor; do the proponents of renewables subsidies believe that water vapor is a “pollutant?”<sup>60</sup> The “social cost of GHG” would be a wise replacement for “the social cost of carbon,” as the former has the virtue of scientific accuracy without assuming the answer to the underlying policy question. More generally, the terms “carbon” and “carbon pollution” are political propaganda, designed to end debate before it begins by shunting aside the central policy questions.

With respect to the first of the three flaws in the SCC analysis by the Obama administration, Office of Management and Budget Circular A-4 is explicit: Only the benefits and costs of regulations enjoyed or borne domestically are to be used in benefit/cost analysis.<sup>61</sup> International effects are to be reported separately. The reason for this is obvious: If domestic costs and global benefits are used in benefit/cost analysis, then the U.S. would be driven to bear all of the regulatory burdens for the entire world.<sup>62</sup> Not only would other economies have

<sup>59</sup> Note that these three problems are independent of the climatology assumptions underlying the analysis of the costs of increasing atmospheric concentrations of GHG. Notwithstanding ubiquitous assertions that “the science is settled,” in reality it is not: The issue of the climate sensitivity of the atmosphere is hotly (!) debated, as noted below, and the existing body of evidence on temperature and other climate phenomena are not consistent with the argument that climate impacts both visible and serious already are visible. See Benjamin Zycher, Paris In the Fall: COP-21 vs Climate Evidence,” *aei.org*, November 30, 2015, at <http://www.aei.org/publication/paris-in-the-fall-cop-21-vs-climate-evidence/>. How rising temperatures might affect such phenomena as weather patterns, ice sheet dynamics, sea levels, agriculture, *ad infinitum* simply is not known. Moreover, scientific “truth” is not majoritarian; it never can be “settled” because new evidence emerges constantly. These observations are not relevant to the benefit/cost critique presented here; but it is important to note that the *policy* issues raised by the GHG/climate question would remain difficult even if there existed both unanimity and certainty on the underlying *scientific* issues.

<sup>60</sup> That the dominant source of tropospheric water vapor by far is ocean evaporation, a natural process, is irrelevant. Volcanic eruptions also are natural, but no one would deny that the massive amounts of particulates, mercury, and other effluents emitted by volcanoes are pollutants.

<sup>61</sup> See Office of Management and Budget at [https://www.whitehouse.gov/sites/default/files/omb/assets/regulatory\\_matters\\_pdf/a-4.pdf](https://www.whitehouse.gov/sites/default/files/omb/assets/regulatory_matters_pdf/a-4.pdf) (p. 15): “... analysis should focus on benefits and costs that accrue to citizens and residents of the United States. Where you choose to evaluate a regulation that is likely to have effects beyond the borders of the United States, these effects should be reported separately.” See also [https://www.whitehouse.gov/sites/default/files/omb/inforeg/regpol/circular-a-4\\_regulatory-impact-analysis-a-primer.pdf](https://www.whitehouse.gov/sites/default/files/omb/inforeg/regpol/circular-a-4_regulatory-impact-analysis-a-primer.pdf).

<sup>62</sup> In this case, U.S. policies would equate marginal domestic costs with marginal global benefits. In other words, the U.S. would reduce emissions of a given effluent to the point that such emissions would be optimal for the entire world, with only the U.S. bearing the costs. If U.S. benefit/cost analysis were to incorporate both global benefits and global costs, the enormous cost calculation would reduce the domestic political viability of any such U.S. policy, and the U.S. cannot enforce regulatory requirements on other nations in an effort to spread the costs. At the

incentives to allow the U.S. to bear all of the attendant costs (that is, to engage in “free riding” on U.S. policies), it would be *economically efficient* for them to do so; if they were to reduce emissions further, global emissions would be lower than optimal, because the global marginal cost of emissions reductions would exceed the global marginal benefits.<sup>63</sup> This also is inconsistent with the standard theory of efficient emissions reductions, under which the marginal cost of those reductions is equated across emitters. Accordingly, the global benefits orientation is inconsistent with the objective, implicit but clear, under the Clean Power Plan of regionalizing emissions reductions, ostensibly to equate the marginal costs of reducing GHG emissions across states, but actually to force most states into regional cap-and-trade wealth transfer systems, the dominant feature of which would be payments from red states to blue ones.<sup>64</sup>

OMB Circular A-4 requires also that federal agencies apply both 3 percent and 7 percent discount rates to the streams of benefits and costs of proposed regulations in order to allow a comparison of the respective present values.<sup>65</sup> The Obama Administration used 2.5 percent, 3 percent, and 5 percent discount rates, but not 7 percent. The reason for this is obvious: At 7 percent, the social cost of carbon becomes small or negative. In the DICE integrated assessment model, the social cost of carbon declines by 80 percent relative to the case of a 3 percent discount rate, from \$61.72 per ton to \$12.25. In the FUND model, the social cost of carbon for 2010-2050 at a 7 percent discount rate declines to approximately zero or becomes negative. In the 2015 IWG revision, the 2050 social cost of carbon is \$26 per ton at a 5 percent discount rate, \$69 at 3 percent, and \$95 at 2.5 percent. It is clear that the effect of changes in the assumed discount rate is very substantial, and the failure of the Obama administration to adhere to the requirements of OMB Circular A-4 was driven by imperatives heavily political rather than analytic.<sup>66</sup>

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same time, if all nations were to adopt a global benefit approach, the efficient level of effluents would be achieved, but this ignores the individual incentives to obtain a free ride on the efforts of others, and so is not a reasonable underlying analytic assumption.

<sup>63</sup> This problem is separate from the industry relocation incentives yielded by the adoption of such policies only by the U.S. Note that in the 2010 Interagency Working Group analysis, the domestic SCC is about 7-23 percent of the global value, or about \$3-8 per ton of GHG emissions if we apply the 2015 IWG estimate of the SCC of \$36 for 2015. See the IWG 2010 analysis at <https://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf>; and the 2015 revision at *op. cit.*, fn. 23 *supra*.

<sup>64</sup> See “‘Summary of Key Points’ in Testimony of Anne E. Smith, Ph.D. at a Hearing on *EPA’s Final Clean Power Plan Rule* by the Committee on Science, Space, and Technology,” United States House of Representatives, Washington D.C., November 18, 2015, at <http://docs.house.gov/meetings/SY/SY00/20151118/104182/HHRG-114-SY00-Wstate-SmithA-20151118.pdf>.

<sup>65</sup> A-4 allows a 3 percent discount rate in addition to the 7 percent rate if a consumption displacement model is deemed appropriate. That obviously is not solely the case for climate policies, which would affect investment flows substantially; but A-4 (p. 34) requires the use of both 3 percent and 7 percent discount rates so as to account for both the consumption and investment effects of proposed regulations, and to allow for sensitivity analysis.

<sup>66</sup> For the DICE and FUND models, see, respectively, [http://www.econ.yale.edu/~nordhaus/homepage/documents/DICE\\_Manual\\_103113r2.pdf](http://www.econ.yale.edu/~nordhaus/homepage/documents/DICE_Manual_103113r2.pdf) and <http://www.fund-model.org/>. See Kevin D. Dayaratna and David Kreutzer, “Environment: Social Cost of Carbon Statistical Modeling Is Smoke and Mirrors,” *Natural Gas and Electricity*, Vol. 30, Issue 12 (July 2014), pp. 7-11; Kevin D. Dayaratna and David Kreutzer, “Loaded DICE: An EPA Model Not Ready for the Big Game,” Heritage Foundation Backgrounder #2860, November 21, 2013, at <http://www.heritage.org/research/reports/2013/11/loaded-dice-an-epa-model-not-ready-for-the-big-game>; and Kevin D. Dayaratna and David Kreutzer, “Unfounded FUND: Yet Another EPA Model Not Ready for the Big Game,” Heritage Foundation Backgrounder #2897, at <http://www.heritage.org/research/reports/2014/04/unfounded-fund-yet-another-epa-model-not-ready-for-the-big-game>. Another problem is presented by the reality that the economic costs of climate policies—increased energy

Note that it is not appropriate to use a low discount rate as a means of increasing the weight given the interests of future generations. This is because future generations are interested not in receiving a bequest of, say, maximum environmental quality, but instead in an inheritance of the most valuable possible capital stock in all of its myriad dimensions, among all of which there are tradeoffs that cannot be avoided. Consider a *homo sapiens* baby borne in a cave some tens of thousands of years ago, in a world with a resource base virtually undiminished and environmental quality effectively untouched by mankind. That child at birth would have had a life expectancy on the order of ten years; had it been able to choose, it is obvious that it willingly would have given up some resources and environmental quality in exchange for better housing, food, water, medical care, safety, *ad infinitum*.<sup>67</sup> That is, it is obvious that people willingly would choose to give up some environmental quality in exchange for a life both longer and wealthier.

Accordingly, the central interest of future generations is a bequest from previous generations of the most valuable possible capital stock, of which the resource base and environmental quality are two important dimensions among many, and among which there always are tradeoffs. That requires efficient resource allocation by the current generation. If regulatory and other policies implemented by the current generation yield less wealth currently and a smaller total capital stock for future generations, then, perhaps counterintuitively, some additional emissions of effluents would be preferred (efficient) from the viewpoint of those future generations.<sup>68</sup>

The IWG benefit/cost analysis of the Clean Power Plan (CPP)---the central “climate” policy proposal from the Obama administration---included “co-benefits” in the form of reductions in ozone and emissions of fine particulates. Indeed: These co-benefits in 2030 are half or more of the benefits (evaluated at a 3 percent discount rate) asserted for the CPP.<sup>69</sup> This “co-benefit” approach is deeply problematic because the Clean Air Act explicitly requires the EPA, upon making an “endangerment” finding for a given effluent, to promulgate a National Ambient Air Quality Standard that “protects the public health” with “an adequate margin of

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costs and attendant effects---are substantially more certain than the benefits, that is, the future impacts of those policies in terms of temperatures and other such phenomena as storms and sea levels. This means that the assumed benefit stream of such policies over time should be subjected to a state-options analysis, or at a minimum to a crude application of a discount rate higher than that applied to the cost stream. See e.g., Daniel A. Graham, “Cost-Benefit Analysis Under Uncertainty,” *American Economic Review*, Vol. 71, No. 4 (September 1981), pp. 715-725.

<sup>67</sup> The source for this life expectancy estimate is a telephone discussion February 16, 2011 with Professor Gail Kennedy, Department of Anthropology, University of California, Los Angeles. Note here the implicit normative assumption that the “interests” of any individual or group are those that they would define for themselves or, more important, reveal through choice behavior.

<sup>68</sup> The capital stock includes both tangible capital and such intangibles as the rule of law, the stock of knowledge, culture, and the like. Greater wealth for the current generation yielded by resource consumption yields conditions allowing the expansion of other dimensions of the capital stock defined broadly.

<sup>69</sup> This is true for both the “rate-based” and “mass-based” regulatory approaches of the CPP. In the regulatory impact analysis for the CPP, the “climate” and “air quality” benefits of the CPP can be compared only with the 3 percent discount rate, because EPA does not provide that direct comparison for other discount rates, interestingly enough. See Tables ES-9 and ES-10 in Environmental Protection Agency, *Regulatory Impact Analysis for the Clean Power Plan Final Rule*, October 23, 2015, at <https://www.epa.gov/sites/production/files/2015-08/documents/cpp-final-rule-ria.pdf>.

safety.”<sup>70</sup> Accordingly, it must be the case that the existing ozone and particulate standards fail to satisfy the requirements of the law, or the CPP will reduce ozone and fine particulate emissions to levels that are inefficiently low, that is, to levels at which marginal costs exceed marginal benefits. *At least one of those two conditions must be true.* Note that the Obama EPA used assumed particulate reductions to justify the various regulations regardless of whether given geographic regions were in attainment, that is, “safe” under EPA regulations. Note also that the IWG uses the assumed global benefits of reductions in GHG emissions as the basis for the SCC analysis, while the CPP net benefits in substantial part are created by assumed reductions in ozone and fine particulates, which are domestic pollutants, as just discussed. This is an inconsistency that went largely unnoticed in the Washington policy community.

It is important to note that even in the context of the climate model used by the EPA,<sup>71</sup> the future temperature effects of U.S. and international climate policies are small at most and trivial for the most part. The Obama administration Climate Action Plan calls for a 17 percent reduction below 2005 levels in U.S. GHG emissions by 2020.<sup>72</sup> In addition, the U.S.-China Joint Announcement on Climate Change calls for an additional 10 percent reduction by the U.S. by 2025.<sup>73</sup> The 17 percent reduction would reduce temperatures by the year 2100 by fifteen one-thousandths of a degree. The additional 10 percent reduction yields another one one-hundredth of a degree. Given that the standard deviation of the temperature record is about 0.1 degrees, these effects would be too small even to be measured, let alone to affect sea levels and cyclones and all the rest.<sup>74</sup> If we assume an additional 20 percent emissions cut by China by 2030, that adds 0.2 degrees; and another 0.2 degrees if we assume a 30 percent emissions cut by the rest of the industrialized world, also by 2030. If we assume also a 20 percent reduction by the less-developed world by 2030, temperatures would be reduced by another one tenth of a degree. The total: a bit more than 0.5 degrees.

Note that these model predictions use underlying parameters highly favorable to the policies under examination, that is, assumptions that increase the predicted effects of the policies. The most important is a “climate sensitivity” (the temperature effect in 2100 of a doubling of GHG concentrations) assumption of 4.5 degrees, a number 50 percent greater than the median adopted by the Intergovernmental Panel on Climate Change in its latest assessment report.<sup>75</sup>

<sup>70</sup> See the relevant language at <https://www.law.cornell.edu/uscode/text/42/7409>.

<sup>71</sup> This model was developed at the National Center for Atmospheric Research, with funding provided by the EPA. See <http://www.cgd.ucar.edu/cas/wigley/magic/>.

<sup>72</sup> See [https://www.whitehouse.gov/sites/default/files/docs/cap\\_progress\\_report\\_final\\_w\\_cover.pdf](https://www.whitehouse.gov/sites/default/files/docs/cap_progress_report_final_w_cover.pdf).

<sup>73</sup> See <https://www.whitehouse.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change>. See also Benjamin Zycher, “Observations on the U.S.-China Climate Announcement,” *The Hill*, November 14, 2014, at <http://thehill.com/blogs/pundits-blog/energy-environment/224076-observations-on-the-us-china-climate-announcement>; and Benjamin Zycher, “The U.S.-China Climate Agreement Hangover,” *The Hill*, December 8, 2014, at <http://thehill.com/blogs/pundits-blog/energy-environment/226272-the-us-china-climate-agreement-hangover>.

<sup>74</sup> See Judith Curry’s analysis at <https://judithcurry.com/2015/11/06/hiatus-controversy-show-me-the-data/>.

<sup>75</sup> See the summary of the recent peer-reviewed evidence presented by Patrick J. Michaels and Paul C. Knappenberger at <http://www.cato.org/blog/collection-evidence-low-climate-sensitivity-continues-grow>. See the IPCC 5<sup>th</sup> Assessment Report at <https://www.ipcc.ch/report/ar5/>.

And even the latter is about 40 percent higher than the median of the estimates published in the recent peer-reviewed literature.<sup>76</sup>

For obvious reasons, these trivial temperature benefits of “climate” policies have not been publicized extensively. EPA has published such an estimate in its regulatory rule for GHG emissions and fuel efficiency standards for medium- and heavy-duty engines and vehicles, and it is revealing:<sup>77</sup>

The results of the analysis, summarized in Table VII-37, demonstrate that relative to the reference case, by 2100... global mean temperature is estimated to be reduced by 0.0026 to 0.0065 °C, and sea-level rise is projected to be reduced by approximately 0.023 to 0.057 cm...

EPA then states that “the projected reductions in atmospheric CO<sub>2</sub>, global mean temperature, sea level rise, and ocean pH are meaningful in the context of this action.” And so we arrive at the benefit/cost conclusion:

[We] estimate that the proposed standards would result in net economic benefits exceeding \$100 billion, making this a highly beneficial rule.

Can anyone believe that a temperature effect by 2100 measured in ten-thousandths of a degree, or sea-level effects measured in thousandths of a centimeter could yield over \$100 billion in net economic benefits?<sup>78</sup> This conclusion is possible only because of the assumptions and approach underlying the SCC analysis; as discussed above, they are deeply problematic.

In short: The climate change/GHG emissions/“social cost of carbon” rationale for renewables subsidies is fatally flawed analytically, and should be reformed in a serious fashion by policymakers.

#### IV. Concluding Observations

Policymakers should ask a straightforward question when considering the enactment or preservation of a given tax policy or provision: Does it make the economy---the total size of the aggregate economic “pie” defined broadly---larger? Gross domestic product---the market value of the final goods and services produced by domestic residents---can be thought of as the size of the aggregate “pie,” but that is too narrow in a policy context, as it excludes important values not

<sup>76</sup> On the recent estimates in the peer-reviewed literature, see <https://judithecurry.com/2015/11/30/how-sensitive-is-global-temperature-to-cumulative-co2-emissions/#more-20572>, <https://judithecurry.com/2015/03/23/climate-sensitivity-lopping-off-the-fat-tail/>, and Michaels and Knappenberger, *op. cit.*, fn. 75 *supra*.

<sup>77</sup> See <https://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2014-0827-0002>,

<sup>78</sup> Marlo Lewis, *et al.* provide a detailed analysis of the fuel efficiency standards for medium- and heavy-duty engines and vehicles at <http://www.globalwarming.org/wp-content/uploads/2015/10/Marlo-Lewis-Competitive-Enterprise-Institute-and-Free-Market-Allies-Comment-Letter-on-Phase-2-EPA-NHTSA-greenhouse-gas-fuel-economy-HDV-rule-Oct-1-2015-Final.docx.pdf>.

captured in reported market prices. At a conceptual level, the issue of whether a given tax (or other) policy has a net positive effect usefully can be answered by examining the central justifications given for the policy. In the context of federal energy-related tax policy, those justifications uniformly are weak or incorrect.

Accordingly, the focus of this hearing on “markets, prices, and consumers” is appropriate, in that it implicitly asks *whether federal energy-related tax policies make the economy bigger rather than smaller*. By “economy,” again, we must mean the economic pie defined broadly to include environmental values and other parameters not captured well in market prices. That is the correct question for policymakers. At a conceptual level, the issue of whether a given tax (or other) policy has a net positive effect usefully can be answered by examining the central justifications given for the policy.

Among the central energy-related tax provisions now in effect, the subventions for various unconventional forms of energy and electricity are subsidies defined properly, and in general are likely to be inefficient, that is, they are likely to yield resource waste and thus to make the economy smaller. The various tax provisions for conventional energy in general are not subsidies defined properly, with one exception, but may or may not improve the efficiency of resource allocation depending on various underlying conditions.

From “energy independence” through the “social cost of carbon,” the modern rationales for energy subsidies have varied in prominence over the decades, but none has been broadly discredited in the public discussion despite the reality that each suffers from fundamental analytic weaknesses.

Energy “independence”---the degree of self-sufficiency in terms of energy production---is irrelevant analytically, particularly in the case of such energy sources as petroleum traded in international markets, an economic truth demonstrated by the historical evidence on the effects of demand and supply shifts from the 1970s through the present.

Capital markets can sustain promising industries or technologies in their infancy---the early period during which technologies are proven and scale and learning efficiencies are achieved---so that the “infant industry” rationale for renewables subsidies is a *non sequitur*. Moreover, there is little evidence that there exist additional learning or scale cost reductions remaining to be exploited in wind and solar generation in any event.

There is no analytic evidence that renewables suffer from a subsidy imbalance relative to competing conventional energy technologies---the data suggest the reverse strongly---and the conventional “subsidies” that are purported to create a disadvantage for renewables are not “subsidies” defined properly as a matter of economic analysis.

Wind and solar power create their own set of environmental problems, and even in terms of conventional effluents and GHG it is far from clear that they have an advantage relative to conventional generation, particularly because of the up-and-down cycling of conventional backup units needed to preserve system reliability in the face of the intermittency (unreliability) of renewable power. And those backup costs---an economic externality caused by the

unreliability of renewable power---are substantially larger than the externality costs of conventional power even under extreme assumptions.

The “sustainability” or resource depletion arguments for renewables subsidies make little sense analytically---the market rate of interest provides powerful incentives to conserve resources for consumption during future periods---and are inconsistent with the historical evidence in any event.

Nor does the “green jobs” employment rationale for renewables subsidies make analytic sense, as a resource shift into the production of politically-favored power must reduce employment in other sectors---resources, after all, are limited always and everywhere---and the taxes needed to finance the subsidies cannot have salutary employment effects. Moreover, the historical evidence on the relationships among GDP, employment, and electricity consumption does not support the “green jobs” argument.

The newest environmental rationale for renewables subsidies---the SCC---is an argument deeply flawed both conceptually and in terms of the quantitative estimates now underlying a large regulatory effort. Moreover, the policies being proposed to reduce emissions of greenhouse gases would have temperature effects trivial or unmeasurable even at the international level, under assumptions highly favorable to the policy proposals. More generally, the terms “carbon” and “carbon pollution” are political propaganda, as carbon dioxide and “carbon” are very different physical entities, particularly given that some minimum atmospheric concentration of the former is necessary for life itself.

It would be hugely productive for the U.S. economy writ large were policymakers to adopt a straightforward operating assumption: Resource allocation in energy sectors driven by market prices is roughly efficient in the absence of two compelling conditions. First: It must be shown that some set of factors has distorted those allocational outcomes to a degree that is substantial. Second: It must be shown that government actions with high confidence will yield net improvements in aggregate economic outcomes. Given the weak history of analytic rigor and policy success in the context of energy subsidies, greatly increased modesty on the part of policymakers would prove highly advantageous.

Mr. UPTON. Well, thank you all, and we will now rotate, and we will ask questions and ask you all to weigh in.

So, many of us support the policy of all of the above on energy, whether it be fossil fuels, renewables, safe nuclear, greater efficiencies, a whole host of things. And I have to say it is often very difficult to measure the effects of the tax code because you have so many different complicating factors from State subsidies. Many States like my State just passed a major new energy bill that was bipartisan and Governor Snyder signed into law. You have some States where you have a minimum of what you have to get from renewable, so, again, my State just went from 10 percent to 15 percent to a mandate, and I think many of our utilities will be able to meet that mandate.

Different definitions of what is renewable, is it new hydro, is it existing hydro? I mean, the whole—and some would argue, of course, that nuclear could be renewable because you have no carbon emissions that are there. Where do you get the best bang for the buck? Is it these mandates that a State may have that they may pass in their State legislature telling the utilities what to do and then letting them figure it all out?

The subsidies as I indicated in my opening remarks on energy, wind energy, in 35 years has gone from \$500 downward, in a large part because of the subsidy because you have those greater efficiencies that are there, and down to \$50 per megawatt hour. What is, you know, if you were rewriting the tax code, if you were starting from scratch what would you do today? And maybe we will just go—Dr. Zycher, we will start with you.

Dr. ZYCHER. Thank you, Mr. Chairman. I would urge you to support all of the competitive rather than all of the above. There is little reason to believe that the subsidies properly defined for unconventional energy, for energy efficiency and investments, and all the rest have net effects that improve economic performance.

With respect to where do we go from here which is, I think, a summary of your last question, the first step is to define what is and is not a subsidy. I have heard a lot of talk here about fossil fuel subsidies which are permanent in some sense, but I have not heard an example. The percentage depletion allowance to pick one example is a form of depreciation. Under certain conditions it may allow too much depreciation. It is not obvious that that problem is worse than the distortions created by cost depreciation based on historical accounting costs.

The deduction for intangible drilling expenses conceptually is not correct, because spending on a capital asset ought to be depreciated not expensed, but that is similar to the treatment of R&D in all industries.

Mr. UPTON. And Mr. Aldy made the point that perhaps you ought to sunset some of these, but that would then take away from the long-term planning, right, in terms of establishing what the ground rules would be as it relates to the investment that whatever the company, the investors would be making whether they be something like an ethanol plant or drilling in the Gulf?

Mr. ALDY. I think, Mr. Chairman, when you consider the sunset provision that I described, you want to think about it in the context of what is the typical investment planning horizon for a project.

This has been a challenge for some of the wind farm developers where they have seen extensions of their PTC as short as 1 year. It takes much longer to do the planning, the contracting, the development of a wind farm.

So I think, if you are looking at this in the context of oil and gas, you would want to have a sunset that is long enough to take account of their current planning cycle.

Mr. UPTON. OK, other comments? Mr. Clemmer?

Mr. CLEMMER. Yes, I guess I would just say that I think, even if you are able to get rid of all of the subsidies in the tax code, there is still the most fundamental problem. The biggest market price distortion has to do with the fact that carbon emissions and other air pollution and public health benefits are not factored into the price of electricity, and so we need to have a policy that does that. I think we have, in this country, used tax policy as a way to implement energy policy, and there are other tools that can be done to do that.

Some of the statements that were made about the effect that wind power is having on market prices are grossly overstated, the fact that the bigger causes have to do with low electricity demand, the inflexibility of nuclear plants to ramp up and down, and the low price of natural gas which has really affected the economics of both coal and nuclear plants much more than renewable-energy technologies.

Mr. UPTON. Mr. Hartman, I will let you respond and then I will yield.

Mr. HARTMAN. Sure. I would say that if you were to start from scratch you would start off with a full expensing approach to capital cost recovery. I mentioned that is there are some provisions for that and those tend to be more fossil fuel heavy in the Code. I would distinguish those very carefully from what we might call subsidies in the form of tax credits or, you know, direct cash grants.

So I think the direction of full expensing is something to start off with, especially in this context of a broader form of tax recovery. That is going to lead to improved growth overall and that is really how you drive the level playing field. And also, for including R&D expenses within that, that is a much more technology-neutral approach to drive.

Mr. UPTON. OK, my time has expired. Mr. McNerney?

Mr. MCNERNEY. Well, I appreciate that, Mr. Chairman.

Mr. Hartman, do you see a carbon price or a carbon dioxide price as a uniform approach to taxing that would have a benefit?

Mr. HARTMAN. Yes, that is sort of the first best approach I think that Mr. Aldy was alluding to. Generally, you price in externalities into the marketplace and that is absolutely the preferable way to approach pollution pricing, internalizing it. I think if you put that in context of making it revenue-neutral and you do so to offset distortionary taxes such as those on capital or the corporate tax that was mentioned in Dr. Murphy's testimony, those are wonderful approaches to both yield economic and environmental co-benefits.

Mr. MCNERNEY. OK, thank you.

Mr. Aldy, would you like to comment on that benefit of carbon pricing?

Mr. ALDY. Yes. In fact, in a sense this will answer the chairman's last question as well. If you were to start from scratch, price carbon through the tax code. It is technology-neutral. We get away from this game where we are going to pick technology winners with each instrument that is using to subsidize this favored technology or that one. We just say here is a level playing field, this has important environmental impacts that affects people in the United States.

And if we are able to do this we can raise some meaningful revenue that actually allows us to do what people really want to do as well on the business side and on the family side, which is to pay lower taxes through the tax code.

Mr. MCNERNEY. Well, I have to say I enjoyed hearing you talk about the current benefits or nonbenefits of fossil fuel tax subsidies in one form or another. Could you elaborate a little bit? It might increase externalities, might encourage other countries not to reduce carbon emissions, and they don't reduce production costs any.

Mr. ALDY. Right. So there are about 10 provisions in the tax code that effectively subsidize the investment in oil, natural gas, and coal development. And these subsidies, the empirical evidence when we look at the research literature, they have a small impact on production, a very small impact on energy prices. Some of the more recent research suggests it might affect the price of gasoline by one penny a gallon.

So we are not really getting much out of that when we look at the expenditures. To the extent that it is increasing production, we do have more pollution. That is bad when we think about people who have chronic bronchitis, asthma, the elderly who may die prematurely from the emissions associated with burning of these fuels.

But I think it is also important that if we are able to engage our economic partners around the world and get everyone to price fuels correctly. In the developing countries they typically subsidize dramatically the price of fuels that causes excess consumption. If they were to remove those subsidies, we would see their emissions of harmful pollutants like carbon dioxide go down. It would actually have a positive impact on the price of oil and the price of gasoline in the United States. We would actually see those prices go down here at home if we were able to leverage our leadership and get them to reduce their subsidies as well.

Mr. MCNERNEY. Well, do you think the United States could be the world leader in terms of producing renewable energy products such as solar and wind energy?

Mr. ALDY. Oh, I think we have seen the innovation is certainly there. The fact that we look at now the manufacturing of solar PV occurs more in China than the U.S., a lot of that is building off of the ideas that were created in America by businesses in America. They have been able to push out more on both the manufacturing and even the deployment of solar. So I think there is a potential risk here that, as we sort of pull back on investments in these new clean-energy technologies, we are going to be ceding market share to other countries.

Mr. MCNERNEY. Thank you.

Mr. Clemmer, could you talk about the tax benefits of incentives for grid storage?

Mr. CLEMMER. The tax benefits?

Mr. MCNERNEY. Or the benefits, the external benefits.

Mr. CLEMMER. The benefits of storage, yes, I think, I mean in terms of there is lots of different benefits from storage. One is to help integrate renewable-energy sources in parts of the country where we have higher levels of renewables; it can provide a role there. With electric vehicles is another way, and also as part of microgrids to help shield communities and critical infrastructure from disruption from storm-induced power outages is another benefit. We have also seen the cost of storage coming down.

So I think, you know, I do think there is a role in the tax code for new technologies to help stimulate growth to help drive down the cost. We have seen that with wind and solar. I think the same could happen with storage as well, we could accelerate that.

Mr. MCNERNEY. And then you see continuing job creation with tax benefits for clean energy?

Mr. CLEMMER. Yes, most definitely. That would help facilitate and enable more clean energy and as well as jobs directly in the storage industry, as well.

Mr. MCNERNEY. So how would you see the number of jobs created with renewable energy compared to the action that the President took yesterday to promote the coal industry in terms of job creation?

Mr. CLEMMER. Frankly, I think the executive order that came out yesterday is not going to do much to help the coal industry. The fundamental problem is low natural gas prices, low prices for wind and solar. Even without the tax credits, the prices for those technologies in some parts of the country is competitive, and so I don't think it is going to fundamentally change that.

But I do think it is really important to have programs in place to help with the transition to a cleaner energy economy, work a transition to diversify some of the economies in those States, but the coal industry is really being hurt by a lot of the market factors and pressures particularly from natural gas.

Mr. MCNERNEY. Thank you.

Mr. UPTON. Thank you. Mr. Olson?

Mr. OLSON. I thank the Chair, and good morning and welcome to our six witnesses. A special welcome to you, Mr. Aldy. Like yourself, my wife is a Duke Blue Devil, class of 1985. She is just getting out of the funk from the smackdown South Carolina gave us 10 days ago, so thanks for being here.

Mr. ALDY. Sixty five points in the second half is tough.

Mr. OLSON. Yes, sir. It was devastating.

My first question is for you, Mr. Hartman. In your statement you mentioned the need to subject all energy-tax provisions to a, quote, objective criteria, end quote, and the need to, quote, equalize, end quote, tax structures. Could you please talk some more about what you mean by that and maybe about how those ideas tie together in terms of a level playing field? And when I say level playing field I mean a playing field that is driven by the free market.

Mr. HARTMAN. Absolutely. No, that is a wonderful framing of the question. First off, I would say that the unequalizing treatment

part that gets back to some prior comments I made on capital cost expensing which is a very good idea in principle to expand cost recovery. What we need to be careful of is doing it in a preferential manner. What we should be doing is across the board, because it will distort capital investments between technologies and across industries if we are just picking winners with it, so we should be doing that, putting everyone on a level cost recovery platform.

The other part there was talking about the objective criteria. So, again, sort of the first best outcome is that we phase to just a tax preference-free world where markets fully decide everything, of course recognizing some constraints in facilitating that.

Mr. OLSON. Politics.

Mr. HARTMAN. Yes, thank you. I think a good way of looking at it is to put some objective criteria in place. So I would say one is to look at the performance characteristics. So, if it is a certain environmental performance characteristic, make it across all technologies that qualify for that. If it has some other reliability performance or other, you know, great technology spillover benefits, then, you know, determine what that should be operationalized and let that qualify, let those qualifications occur across multiple technologies and industries.

And also—and we have seen some progress on this front in terms of setting phase-out provisions, so, even though I disagree with the infant industry argument that I think was well-articulated by some of my counterparts here, I think that if we are going to use that as a crutch to support tax credits, then we need to have firm phase-out provisions based on when economies of scale are targeted and hit.

Mr. OLSON. Thank you. Further question on, as you all know not all tax policy is the same. For example, some policies give people a credit for the money they spent to build a facility or help them recover the costs that they spent working on a project, but some credits like the production tax credits incentivize projects to operate after they are built. And Mr. Hartman, can you talk about the differences between how these certain tax credits work and some of the positive/negatives associated with these policies?

Mr. HARTMAN. Sure. So, on one hand, most of the economic literature—for example looking at the investment tax credit versus the production tax credit for clean-energy technologies—most of that research, you know, shows that the investment tax credits skews things toward capital-intensive technologies, which, of course, if we are using it as a back-door approach to correct for the pollution externality, what we actually care about is displacing emissions. We don't care about building it, per se.

So that is where some of the economic literature says the production tax credit is better. However, when we get into the actual production profile of it, it lowers the effective cost of operating these plants. And I have seen this because I have had access to some privileged information in my years that has clearly shown that these resources do offer negativity into these markets and that does result—especially in areas where there is transmission constraints on the grid such as in the Midwest, we will see a lot of those prices go negative for sustained periods and that artificially distorts these markets.

Mr. OLSON. Dr. Zycher, do you want to comment, sir, within 30 seconds? I am sorry for the time crunch, but just about the tax policies how they differ between building and then after its built getting some—

Dr. ZYCHER. Yes. There is no question that the investment tax credit for solar production provides weak incentives for actual output of power and powerful incentives for simply building facilities. A good example of that is the Ivanpah Solar Power plant in the California Mojave Desert, the performance of which has been vastly smaller than was advertised. The production tax credit provides incentive to produce excessively expensive power, particularly if we do the accounting correctly and it too has its own set of distortions. That's right.

Mr. OLSON. Thank you. My time's expired. Don't despair. Coach K does not recruit, he reloads. Duke will be back.

Mr. UPTON. The Chair recognizes Mr. Peters. I am sorry, Mr. Pallone. I didn't see you come back. I am sorry, Frank. Mr. Pallone.

Mr. PALLONE. Thank you, Mr. Chairman. The committee has spent a lot of time today talking about markets and how the policies we implement can change energy markets. And one of the major problems with this discussion is that the fossil fuel industry likes to overlook the greatest market distortion that exists and that is the public health, environmental costs of pollution.

My colleagues and I on the Democratic side have had to remind our Republican counterparts time and again that these costs over the course of—well, we have talked about it many times in dozens of hearings, and those costs include millions of missed work and school days, greater health costs for children and the elderly struggling with asthma and other respiratory illnesses and higher mortality rates.

So I wanted to ask Dr. Dinan, do you agree that energy generated from burning fossil fuels generates social costs? And then maybe tell me what does the CBO estimate those costs to be.

Dr. DINAN. Well, the Congressional Budget Office has not actually weighed in on what the benefits of reducing carbon dioxide emissions are. We have in previous work indicated that there are risks associated with that and that there is a lot of uncertainty. So—and we have also talked, but we haven't quantified the benefit. We have also indicated that if the most cost effective way of reducing those emissions would be to put a price on carbon in some way, either by putting a tax on those emissions or by enacting a cap and trade program.

Mr. PALLONE. But then these costs are not reflected in the price of energy generated from fossil fuels. We don't see that either, right, with these costs?

Dr. DINAN. Yes, we have stated that. It is what we call an externality. The prices aren't, the costs associated with, the environmental costs aren't reflected in the prices that consumers pay.

Mr. PALLONE. And then that means that these firms, you know, the fossil fuel industry, the firms have no incentive to consider them when making business decisions even though these costs weigh heavily on society and fall on the backs of parents and seniors or whatever.

Dr. DINAN. Yes. That is the rationale behind putting a price on those emissions is to internalize them and give firms an incentive to take them into account when they decide how to produce energy and what types of technologies to use, and also consumers' incentives to take those costs into account when they decide how much energy to consume and what types of energy to use.

Mr. PALLONE. All right, thank you.

Let me ask Mr. Hartman, in your written testimony you discuss the existence of pollution externalities. Do you agree that pollution from fossil fuels creates externalities that distort the market?

Mr. HARTMAN. Yes.

Mr. PALLONE. And do you believe that action is necessary to correct these externalities so that third parties don't have to shoulder the heavy cost of pollution?

Mr. HARTMAN. I believe correct action should be taken on it. We need to be careful to make sure that the medicine is not harsher than the disease and I think that is where we get into the question of second, third, and fourth best policy mechanisms.

Mr. PALLONE. OK. Now a number of witnesses today have said that in recent years renewable energy sources are getting the lion's share of tax expenditures. So let me ask Dr. Murphy, your testimony claims this amounts to artificial encouragement for the renewable-energy sector, which I find interesting given that our country has been providing different types of artificial encouragement for fossil fuels since before you and I were born—a long time ago, in my case.

Dr. Murphy, yes or no: Do you believe that the PTC provides artificial encouragement to the wind sector?

Dr. MURPHY. Yes, I do think the PTC provides artificial encouragement. And that is why I focus—I think the negative wholesale electricity prices that wind operators are offering is a clear signal that that is not a normal market outcome.

Mr. PALLONE. OK. So then, and maybe just yes or no because we are running out of time, do you consider percentage depletion an artificial encouragement to the oil sector?

Dr. MURPHY. I think it is, I would agree with what Mr. Zycher was saying that it is perhaps an artificial tax code treatment, but I don't know if the rationale was to encourage output.

Mr. PALLONE. All right. What about intangible drilling costs?

Dr. MURPHY. Again, it may be incorrect tax policy, but I don't know what the rationale was for that.

Mr. PALLONE. All right.

Mr. Aldy, do you consider percentage depletion and intangible drilling costs as artificial encouragement?

Mr. ALDY. Yes. They distort the investment decision. They make it easier for someone to make money off of an oil and gas project than if they were to invest in say a new steel mill or a new commercial retail facility. So it is clearly distorting the investment decision favoring that technology and favoring that investment over other options in the economy.

Mr. PALLONE. All right, thank you very much. Thank you, Mr. Chairman.

Mr. OLSON [presiding]. The gentleman's time has expired. The Chair calls upon the vice chairman of the full committee, Mr. Barton, for 5 minutes.

Mr. BARTON. Well, thank you. And Mr. Vice Chairman of the subcommittee, I am not a Duke graduate. I am a proud graduate of Texas A&M which didn't make anything this year. They didn't. We are just proud to be proud, I guess.

I am going to ask, I guess, Dr. Murphy, is there any country in the world that has a better, more diversified energy production market than the United States?

Dr. MURPHY. Not to my knowledge.

Mr. BARTON. Not to mine either. We are number three in oil production, could be number one. We are number one in coal production, number one in natural gas production, number one in hydro production; I think we are number two in ethanol. I believe Brazil is ahead of us in that. I don't know where we are in the solar industry, but we would be in the top five, and I believe we are number one in wind production. That is not bad.

So is there anybody on the panel that disagrees with the statement that—or let me rephrase it. Is there anyone on the panel that thinks we would be better off if we went from a free-market, capitalistic energy sector to a government-owned, government-controlled energy sector?

Dr. MURPHY. So, if I could just make one comment on that related to the earlier question, too, that, yes, all of the above from the Institute for Energy Research perspective means a level playing field, and let the market determine the outcome. So not favoring fossil fuels, not favoring renewables, just let markets, consumers, and producers choose the right mix.

Mr. BARTON. Right. Well, I can't say that we are a total level playing field, there are people on these panels that disagree with that statement. But at least we start from the premise that we are going to let free market capitalism dictate our energy sector, and then the government, both at the State level and the Federal level, we tinker around with it with tax policy and various research grants and things like that.

If you will all agree that we are better off having a privately owned energy market and energy sector, the next question would be, logically, is it appropriate to create incentives for various sub-components of that, incentives, subsidies, and on occasion penalties? Anybody have a comment on that? Mr. Aldy? Professor Aldy, I guess.

Mr. ALDY. Yes. Congressman Barton, I believe when we talk about a level playing field in a competitive market I think it is important, as has already been discussed, for us to fully account for the social cost of different kinds of energy. It is not a level playing field when we have some technologies that don't emit any air pollutions that contribute to premature mortality competing with technologies that do cause premature mortality but don't have to actually bear those costs, invest in technologies to reduce that exposure to the elderly and to children around the country.

So I think it is important when we think about a competitive marketplace that we are ensuring that the market is actually delivering what is in everyone's social best interest. If I could go out and

buy clean air in the market I would go do some of that and the market would help deliver it, but the fact that you can't do that makes it very difficult.

Mr. BARTON. I didn't postulate that our energy policy is absolutely a level playing field. I haven't said that. I admit that we do, you know, I happen to think it is OK to subsidize or at least incentivize through the tax code some oil and gas exploration and production. I don't buy into this concept of social cost of energy. A cost is a cost. A dollar monetized, either produce it or transport it and then what it costs to consume it, so I am not a fan of that.

Dr. Zycher?

Dr. ZYCHER. Yes, Zycher. I really have to take issue with most of the other people on the panel and with some of your colleagues up on the dais. The argument that the externalities created by fossil fuel production and use have not been internalized simply ignores the entire framework of the Environmental Protection Agency regulation. Those regulations reduce, or at least ostensibly require, a national ambient air quality standard that protects the public health with an adequate margin of safety.

If people want to argue that the EPA regulatory framework for any given pollutant is insufficient, fine, make that argument. I have not heard that. And then there is the further argument that somehow wind and solar power are clean. No, they are not. Because of the backup units required to maintain system reliability, you actually get more pollution rather than less, however defined, because of wind and solar power. That is what the Bentek study of Colorado and Texas found, and it is really rather obvious. We don't talk about that, but the premise here is really quite wrong and—

Mr. BARTON. My time has expired. I agree with what you said. I also think that you need to have a regulatory framework because free market capitalism sometimes does not account—

Dr. ZYCHER. Right.

Mr. BARTON [continuing]. For some costs in the environmental area that need to be regulated at the State and Federal level. And with that I yield back, Mr. Chairman.

Mr. OLSON. The gentleman's time has expired. The Chair calls upon the acting vice chairman, Mr. Peters from California, for 5 minutes.

Mr. PETERS. Thank you, Mr. Chairman. I have to say also I am a Blue Devil, and the only two good things are we beat Carolina 2 out of 3 in the ACC championship, and we are less distracted than we would be typically this time of year, so we can pay attention to this hearing.

Mr. ALDY. I would rather be distracted.

Mr. PETERS. Yes, me too. I thought Mr. Hartman did a great job of sort of laying out the classical economics of the free market that would drive good competition and ultimately low prices for consumers. And what I was curious about, though, is whether CBO—maybe Dr. Dinan has looked at if you wiped out all these preferences in theory, would you understand what the effect would be on domestic job creation, because I suspect that other countries might be subsidizing.

Dr. DINAN. Looking at the effects of reducing tax preferences on jobs is a very challenging task because there are, you know, for example, studies that look at how much jobs would be created in the wind energy, you know, associated with the tax preference don't look at what would have happened in the absence of that.

Mr. PETERS. Right.

Dr. DINAN. So where would employment have been greater in the absence. And so CBO has not taken a careful, has not yet looked at the effect of say a cap and trade program on jobs and individual industries, although we have said that in total putting constraints on the economy can result in a small reduction.

Mr. PETERS. I don't want to labor it because I don't have a lot of time, but that wasn't my question. My question was about if you just removed all the tax expenditures related to energy to level the playing field in a really clean way along the lines of what Mr. Hartman did, is there an understanding of what the effect would be on job creation in these energy sectors? But I am going to leave that to maybe follow up on because it sounds like it would be a difficult thing to assess.

I did want to say that Mr. Hartman's statement acknowledges that a targeted tax preferences for—I am sorry—that pricing externalities is the most efficient policy for dealing with this. Do you have a suggestion for us? I know there has been some criticism of the social cost of carbon. Do you see that as an appropriate way to calculate the externalities of carbon, or how would you do it if not that?

Mr. HARTMAN. I think generally the approach in theory is absolutely the appropriate way to go. Right, the idea is to quantify all the damages, you know, going forward and that is definitely the basis. Now I think when we start getting into the methodology behind it, it gets very difficult. So, in a large part, the damage valuation of climate change largely comes down to the choice of discount rate because most of the folks that are hurt by this are our future generations.

Mr. PETERS. Right.

Mr. HARTMAN. And also potential catastrophic effects associated with climate change and figuring out what the triggers of those are there is an immense load of scientific uncertainty on that front. And so it is very hard to even get good estimates with an order of magnitude, but I think it is a worthwhile exercise to try and perform it.

Mr. PETERS. And you have to set it somewhere. You have to make some assumptions about what is going to happen so that you can actually provide a cost for this externality if you are going to recover it, right?

Mr. HARTMAN. And doing the sensitivity analysis just gives us a sense of what we know and what we don't know as well, and I think that is still very helpful.

Mr. PETERS. Finally, I want to ask, I think, Mr. Aldy about something I have come across called the Conservative Case for Carbon Dividends from James Baker, George Shultz, Hank Paulson, and some other renowned Republicans. I don't know if you are familiar with this, but the idea is that you would have a gradually increasing carbon tax. You would do dividends back to Americans with

what you collected and you would do border carbon adjustments. And there is some argument that you could roll back regulations as well. Have you evaluated this plan? Do you have a view on how it would work?

Mr. ALDY. I do. I think it is an excellent plan. I have also put out a proposal for how you could think about taxing carbon and returning revenues back to the economy. The idea that everyone would get a check every month is, I think, a really important way to ensure that families aren't adversely impacted by a carbon tax. There is a concern that it will increase energy prices.

But if you have energy prices in a world in which you are getting a check every month that dividend, then that allows you to have the freedom to figure out what are the most effective ways to use those monies, whether it is to become a little bit more energy efficient or for other things that matter to your family. So I think it is an excellent idea and worthy of serious consideration.

Mr. PETERS. And in 10 seconds, Mr. Hartman, I don't know if you have a reaction to that approach.

Mr. HARTMAN. I would emphasize that the dividend approach is probably the most if not the least efficient way to redistribute that revenue. I think you are better off going after distortionary taxes especially capital.

Mr. PETERS. OK. Thank you very much. My time has expired. I appreciate it.

Mr. OLSON. The gentleman's time has expired. The Chair calls upon the subcommittee chairman of the Digital Commerce and Consumer Protection, Mr. Latta, for 5 minutes.

Mr. LATTA. Well, thank you very much, Mr. Chairman, and thanks very much for our panel for being here, as you have probably heard that we have a couple of hearings going on two committees today, or subcommittees.

But if I could ask, is it Dr. Dinan? I want to make sure I pronounce your name properly. Would a comprehensive evaluation of the cost effectiveness take into account costs and benefits to consumers in the economy?

Dr. DINAN. Yes. In general, well, a cost effectiveness measure is just looking at how much it costs producers and consumers or taxpayers to achieve a given goal. It is not measuring that goal that cost against the benefit. So generally, a cost effectiveness measure when we compare different policies you are saying does this get a reduction in a certain pollutant or say an increase in domestic production at a higher cost or a lower cost in an alternative policy.

Mr. LATTA. Maybe that follows up with my next question. How do you measure whether the consumers are benefiting from a particular tax treatment then when you are talking about the different types of measurements then? How would that measure for the consumer then if they are benefiting from that?

Dr. DINAN. So are you referring to the measures that we talked about in my testimony about the cost of the greenhouse gas emission reductions?

Mr. LATTA. Right.

Dr. DINAN. OK. In that case it was looking at how much additional dollars—I am sorry. Yes, how much additional cost is imposed on the economy to get the reduction in greenhouse gas emis-

sions, so it is not explicitly taking into account the cost, the benefits to consumers of achieving that which is why you would compare it with something like the social cost of carbon. In particular that measure was looking at cost, lost foregone revenue associated with achieving that outcome.

Mr. LATTI. Thank you.

Dr. Zycher, if I could ask you how has the tax code affected consumer choice?

Dr. ZYCHER. Well, I think the primary impact of the current tax treatment of various energy forms is to allow given States to mandate market shares for renewable power, wind and solar power, and the production tax credit and the investment tax credit allowed those States to shift a substantial number of the amount of the costs of those policy choices onto taxpayers in other States.

And so I think that, to answer your question, consumers are constrained to consume an energy mix that is more expensive than would otherwise be the case because of the tax policies that I have just mentioned.

Mr. LATTI. Thank you very much. Mr. Chairman, I yield back.

Mr. OLSON. The gentleman yields back. The Chair calls upon Ms. Castor from Florida for 5 minutes.

Ms. CASTOR. Well, thank you, Mr. Chairman. This is a very important hearing the day after the Trump administration has begun to unwind the Clean Power Plan and our carbon pollution reduction goals. In the face of overwhelming evidence of the need to reduce carbon pollution and the need to generate electricity in cleaner ways, the Trump administration is instituting an energy policy that is more suitable to 50 years ago in America.

It is not a policy for innovation. It is not a policy to keep the boom in clean-energy jobs going. It is a policy that will keep costs on our kids and future generations. See, America needs carbon pollution reduction goals and we also need a tax policy and tax incentives to help address the rising costs of the changing climate.

I represent the State of Florida and there has been a lot of talk about cost, are costs factored in when you consider energy policy? And let me share with you some of the costs we are facing in Florida. And Florida is not unlike other States, but we have a lot at risk. We anticipate significant cost increases in flood insurance. We anticipate significant costs in property insurance, whether that is what happens on the coast or from extreme weather events. We are already seeing rising costs of beach renourishment.

The economy in Florida is quite dependent upon clean water, clean air, and our beautiful beaches. People will probably have to start paying more in property taxes as local governments begin to repair their water infrastructure and wastewater infrastructure. Already in Miami-Dade County they are doing a lot of that. Not to mention air conditioning bills as the number of oppressively hot days continues to increase. In fact, the Florida League of Cities said that because Florida has more private property at risk from flooding than any other State, climate change could cost 69 billion in coastal property damage by 2030, and 152 billion in damage to coastal Florida properties by 2050.

So Ms. Dinan, for the nonpartisan Congressional Budget Office as you are preparing to give advice and analyze the cost of certain

tax incentives as the Ways and Means Committee begins to discuss tax reform, do I understand it that these type of costs will not be factored in when we ask the CBO for cost analysis of fossil fuel tax incentives or the production tax credit or the investment tax credit?

Dr. DINAN. Just to be clear, it is the Joint Committee on Taxation who estimates the cost of those tax expenditures so we rely on their estimates, and those estimates really just reflect the foregone revenue that is associated with them.

Ms. CASTOR. So they wouldn't include property insurance, flood insurance cost to consumers at home?

Dr. DINAN. When they estimate the cost of the tax expenditures? No. That would be something that we would do in part of a broader analysis.

Ms. CASTOR. What would you do that broader analysis? What would trigger a broader analysis?

Dr. DINAN. Well, in general we do these longer term, more complicated studies at the request of either a ranking member or a chair of a relevant committee.

Ms. CASTOR. OK. Mr. Clemmer, is that a good way to really estimate the cost to families back home when we are trying to make decisions on tax expenditures and tax policy?

Mr. CLEMMER. No. And I think you bring up a really good point which is the cost of climate change. Even though there is some uncertainty about what they are going to be, there is a cost and it is significant, and there have been a lot of studies out there that have shown that. And some of the comments that were made earlier about discount rates in the future, you know, those are actually taken into account in the social cost of carbon estimates that the Government was using with a wide range of costs.

But the other point I want to make, as you are pointing out in your comments, is that we are already seeing some of the costs of climate change. While you can't put any, on one particular storm you can't associate with climate change, we have seen an increase in drought, in wildfires, in coastal flooding and storm surge, and that is having a real cost on those communities and the trend has been increasing over time and those events have been increasing over time. And so we need to—as we have been discussing on this panel—need to fairly account for those externality costs.

In my testimony, I mentioned the DOE. There have been a bunch of DOE studies recently that tried to quantify the benefits of renewables in terms of reducing those costs from CO2 emissions and from other pollutants and the public health impacts associated with it. And what they found was that the benefits were two to three times greater than what the production tax credit is, so I would urge people to take a look at that.

Ms. CASTOR. Sure, thank you.

Mr. OLSON. The gentlelady's time has expired. The Chair calls upon gentleman from Mississippi, Mr. Harper, for 5 minutes.

Mr. HARPER. Thank you, Mr. Chairman, and thanks to each of you for being here. Dr. Zycher, I would like to ask you a few questions if I may. And one thing that just amazes me when we look at intangible drilling costs more particularly, how that enables independent producers across the country to take what is a very high risk business. What is your view or take on IDC?

Dr. ZYCHER. Well, conceptually, labor costs incurred in the creation of a capital asset should be depreciated not expensed. At the same time, the deduction for intangible drilling expenses is allowed, basically R&D expenditures, everywhere, and so it is not really a subsidy for the oil and gas sector. It may be inefficient economically, but it is not a subsidy that is specific to that sector.

And so I would be perfectly happy if—and it is not available, I guess, or it is available in limited formed integrated oil companies if I recall correctly. So I would be perfectly happy and I think it would be efficiency-inducing if Congress were to eliminate it across the board, but simply eliminating it for one sector, I think, would not be appropriate.

Mr. HARPER. All right. There has been discussion here of, you know, certainly cap and trade or more recently carbon tax. Give me your views on the carbon tax, what that does to the economy, what that means as far as tax policy.

Dr. ZYCHER. Yes. The carbon tax is really a terrible idea. And the study from the Climate Leadership Council that one of your colleagues mentioned earlier, I actually wrote a paper on that. It was published on the AEI Web site 3 weeks ago. It is deeply unserious. The carbon tax provides incentives for the Government to maximize revenue rather than optimize the level of emissions.

The argument that Congress will simply send an equal check to every American is preposterous. The losers will have to be compensated more heavily than others. The carbon tax adjustment at the border is unworkable because of the supply chain phenomenon across countries, et cetera. The predictability argument made by Mr. Shultz and Mr. Baker refutes itself. They argue that the policy is predictable, but then they argue that after 5 years there should be a blue-ribbon commission to recommend whether there should be an increase in the tax. That proposal even among the several carbon tax proposals that have been made, that particular proposal from the Climate Leadership Council is deeply unserious and really ought not be paid too much attention to.

A regulatory framework, surprisingly enough, is more efficient than a carbon tax in this context because it does not provide incentives for Congress to impose overly and stringent goals in terms of emission restrictions because of the availability of the revenues.

Mr. HARPER. OK. You know, some have argued obviously that tax subsidies are necessary to correct market failures. Generally speaking, how well has the Government predicted those so-called market failures and has the tax code done a good job correcting them?

Dr. ZYCHER. I don't think so. The tax code subsidizes wind and solar power heavily despite the fact that they are polluting on that because of the need for backup generation that has to be cycled up and down. I made that point several times here today. EPA probably has incentives to overregulate because of the ideological and budget maximization incentives of the bureaucracy. But because of the power under the Congressional Review Act and possibly a REINS-type act, I think that that problem is being addressed by the current Congress.

More generally, in the context of climate change, all the assertions here that we have heard about how the effects of increasing

greenhouse gas concentrations are becoming increasingly serious ignore the fact that there is simply no evidence in support of that. If you look, the temperature data are ambiguous, the correlation between increasing greenhouse gas concentrations and temperatures is actually very, very poor. The Arctic and Antarctic sea ice data provide conflicting stories. There is no evidence in the U.S. that flooding is correlated with increasing greenhouse gas concentrations.

If you look at the data on wildfires from the National Fire Inter-agency Program in Boise, Idaho, there are no trends since 1985. The Palmer drought severity index shows no trends since 1895. There is simply no evidence that increasing greenhouse gas concentrations are having serious effects either in the U.S. or nationally. If you look at the cyclone data, the satellite data on cyclones, there is no trend since the early 1970s. Since 1954, there is no trend in tornado activity that is correlated with increasing greenhouse gas concentrations in the U.S. The assertions we have heard today from a number of people that there is a crisis because of increasing greenhouse gas concentrations is simply not supported by the evidence.

Mr. HARPER. Thank you, Dr. Zycher. My time has expired. I yield back.

Mr. OLSON. The gentleman's time has expired. The Chair calls upon the gentleman from New York, Mr. Tonko, for 5 minutes.

Mr. TONKO. Thank you, Mr. Chair. I agree we should hope to have a level playing field and was discouraged that many worthy emerging technologies were left out of the December 2015 ITC extension. Those included concepts like fuel cells, CHP, geothermal, and distributed wind. We should correct that and give these technologies ITC parity. I think it is a looming correction that needs to be addressed.

With that said, wind and solar PV accounted for over two-thirds of new electricity generating capacity installed in 2015. Undoubtedly, tax policy has played a role, but is far from the only factor bringing these technologies online.

So Mr. Clemmer, do you believe State Renewable Portfolio Standards requirements have played a role in bringing more renewables into our energy mix?

Mr. CLEMMER. Yes, definitely. We have done a lot of research on that and there has been a lot of research from the national labs on that. And yes, they are one of the key drivers. They are actually in some ways more effective in the sense that they provide more long-term certainty of the industry. There has been lots of cost-benefit studies done on those showing that the cost impacts are very minimal. And as I mentioned in my testimony just a few minutes ago, one of the studies about the benefits from those being two to three times greater has to do with State renewable standards.

I wanted to just quickly make a comment about what Dr. Zycher keeps bringing up, this issue of renewables being more polluting than fossil fuels, which is ludicrous.

Dr. ZYCHER. Well, that is not what I said, Mr. Clemmer.

Mr. CLEMMER. And in fact the—well, you said it makes more generation to back up renewables that increases pollution.

Dr. ZYCHER. Yes.

Mr. CLEMMER. And the study he is referring to has been thoroughly debunked. It was a long time ago, and there have actually been dozens of studies by regional transmission organizations, utilities, the national labs that have all shown the amount of balancing that is needed for renewables is fairly small and the cost is actually fairly small too, on the order of five to ten percent of the wholesale price of electricity. So I completely disagree with what he is saying.

Mr. TONKO. Thank you for that clarification. I think it is good to have on the record. I would point out that when I—my last workplace before this was at NYSERDA, the State Energy Research & Development Authority, and we saw tremendous efforts made in our renewables with the portfolios, and as an example we have set a goal of 50 percent of electricity in New York coming from renewable sources by 2030.

Again, Mr. Clemmer, what about corporate procurement policies and consumer preferences for clean energy, what role do they play?

Mr. CLEMMER. I think in the past few years they have been playing a huge role. We have seen a lot of large corporations directly purchasing and having power purchase agreements with renewable-energy developers and renewable-energy facilities, which is another indication that renewables are becoming more cost effective and the fact that it is good for consumers. They wouldn't be doing this if it wasn't good for them and it wasn't affordable and cost effective for them to do it, as well as lining up with their corporate views about the environment and things like that.

So I think there has been an enormous trend for both wind and solar in that way in the last couple of years.

Mr. TONKO. Thank you. And since 2008, land-based winds cost has decreased by 41 percent and there has been a 64 percent decrease for utility scale PV. Has the increasing cost competitiveness of renewables, much of it due to technology improvements, played a role in their proliferation?

Mr. CLEMMER. Yes. I think that the two main factors have been, you know, for wind it has been a combination of capital cost reductions due to some more economies of scale with that technology, but it has also been due to increasing levels of output or capacity factors as we often refer to it. In the best sites in the country right now, capacity factors for wind turbines are above 50 percent and the increase in output due to taller towers, longer blades, and more sophisticated power electronics have all helped boost capacity factors and made it viable for wind projects to be sited in areas of the country that were previously thought not to be cost effective for the technology. So innovation has played a key role.

Mr. TONKO. Thank you.

And again, Mr. Clemmer, many people have been using cost estimates looking at 2016 to 2020. Doesn't that ignore the fact that only some of these credits are permanent and have existed for many decades and will continue to do so long after 2020?

Mr. CLEMMER. Yes. It ignores that aspect, but it also ignores the historic treatment of different technologies. And in my testimony I give an example of looking back to basically 1950, and the amount of subsidies that have gone to wind power between that time frame and 2015 have been about three percent of the Federal subsidies,

whereas fossil fuels have provided almost two-thirds and nuclear power about 20 percent.

Mr. TONKO. If we looked at a snapshot from 2016 to 2066, for example, we would probably get a different portrayal, right, of the impact?

Mr. CLEMMER. Yes. But I think that would be very uncertain to look at that given, you know, the uncertainty about what is going to happen with policy and so forth. But if you were to just look at it from a snapshot of right now going into the future and the provisions that are going to get sunset at a certain point in time would be one way to do it, then you would see a much different picture.

Mr. TONKO. OK, thank you. I believe my time has expired so I yield back.

Mr. OLSON. The gentleman's time has expired. The Chair calls upon the gentleman from West Virginia, Mr. McKinley, for 5 minutes.

Mr. MCKINLEY. Thank you, Mr. Chairman. We have spent over the last numbers of years quite a bit of time in this committee with panels coming in about grid reliability and how we maintain our industrial might in this country. My concern a little bit is that let's just say if we could just imagine an elementary level, if we were to do away with all of our fossil fuels and we were totally reliant on the wind, solar primarily, what would our grid look like? Would we have a reliable grid to be able to maintain our might if we had a complete reliability on renewables?

Dr. Zycher, if I could get your view on that.

Dr. ZYCHER. Yes. Is your question if we had a hundred percent grid powered by wind and solar power?

Mr. MCKINLEY. Right.

Dr. ZYCHER. Well, then we would have an extreme version of what happened in West Germany and the U.K., highly unreliable and highly expensive, devastatingly expensive electricity delivery system. And I don't think, I really rather doubt that if people who argue—

Mr. MCKINLEY. So if that were correct, and I don't disagree with you on that coming from a coal State, but if that is correct, then why are we having policy that is moving us in that direction?

Dr. ZYCHER. Well, I am not really a political expert on why we are subsidizing what we are subsidizing. I only can talk about the effects, most of which are adverse. What I really do find amazing is the argument simultaneously from the proponents of wind and solar power that, A, they are now competitive in a cost sense with fossil fuel generation; and, B, we should continue the subsidies. You really can't make both of those arguments simultaneously. If they are competitive, they don't need the subsidies, and if they need the subsidies, they are not competitive.

Mr. MCKINLEY. OK. Well, I am not opposed to wind and solar. I think it is unique. I think it's something that makes it truly part of all of the above. I am willing to support that. My concern is that we keep subsidizing an industry that I think has matured to a level that perhaps it is unnecessary to subsidize it, especially if it gives us and under the extent, degree, it is an unreliable grid that we develop by pursuing this policy.

And so Dr. Murphy, I would like to get back to a question you said or you put in your paper and that was about how wind can actually get into the market into the PJM when they go to market on getting power at a virtually negative rate and still can make money on that because of the subsidy. Could you explain that on an elementary level, how you can actually bid in negatively or almost at cost and still make money with it?

Dr. MURPHY. Sure, yes. So I should mention that there are cases where that might actually be sensible, like if a nuclear plant doesn't want to completely shut down. So it is not that this is only possibly due to this one factor, but I think if you look at the data, the frequency with which these negative wholesale prices, so yes, they are legitimately negative prices where producers of electricity are paying people to take their product from them.

And so I think a main reason that we have seen a prevalence of this increase is the production tax credits. So you are an operator, if you own one of these things, for every megawatt hour that you sell your tax bill goes down \$23. And so, as long as the marginal costs of production aren't that high, you would be willing to even sell at a negative price, because all things equal to you individually you make money doing that because it reduces your tax bill.

Mr. MCKINLEY. OK, and just in the closing let me just make sure I understand, Dr. Murphy, your statement you make in your written testimony. And you may have made it in verbal, I might have missed that but there was talk about the Federal support for the wind and solar now is in the, particularly solar, let's just focus on solar, is somewhere, I believe you listed it. It was \$231 a megawatt and coal is at 57 cents. Am I reading your statement correctly?

Dr. MURPHY. Yes. Well, what that was, yes, that was from the written testimony and that was for looking at fiscal year 2013. EIA had looked at the total Federal support, so that included direct grants not just tax preferences and then we adjusted it for a per megawatt hour basis.

Mr. MCKINLEY. OK. So given the difference between \$231 and 57 cents, how can anyone in good conscience say that we are trying to not pick winners and losers here in Washington?

Dr. MURPHY. Well, right, I agree with you. And I also think like some of the other comments made reflect that, that talking about how historically there hasn't been much support for wind and solar and, right, and that is why we haven't seen any real generation from wind until very recently. So I think that underscores the point that the expansion of wind thus far is driven by the tax code and other mandates.

Mr. MCKINLEY. I know I am over time, but just would you agree that that would provide, if we were to become more reliant on wind and solar that we would have an unreliable grid?

Dr. MURPHY. I think so, just obvious common sense that wind is intermittent. So, even in areas where it does make economic sense, you wouldn't want to have your whole grid just dependent on that, because sometimes the wind is not blowing.

Mr. OLSON. The gentleman's time has expired. The Chair calls upon the gentleman from Iowa, Mr. Loeb sack, for 5 minutes.

Mr. LOEB SACK. Thank you, Mr. Chair. This has been pretty fascinating. I used to teach at a small college and not economics, polit-

ical science, but we had a lot of theoretical discussions. There has been a lot of theoretical discussions today. There have been a lot of, I think, false choices presented to us. I am one as a strong supporter, for example, of wind and solar, but I completely agree that we are never going to get to the point where we can depend completely on wind and solar. We simply probably will never have enough storage capacity for one thing to do that without relying upon some other forms of energy. So I think we have a situation here where we have false choices often get presented to us and I think that is unfortunate.

And I kind of want to bring this back to the real world of Iowa and my home State, where some of you may know that our electricity generation—there is about 40 percent now from wind energy, and that is supported on a bipartisan basis in the State of Iowa. We have a Republican Governor who is for this, we have a Republican senator, Chuck Grassley, who is essentially the father of the production tax credit. And I am a Democrat, the only Democrat in the Federal delegation who pushes really hard for this. There is nothing partisan about it. It is about making sure that we create great jobs in Iowa. It is about making sure that we do the best we can to have as clean energy sources as we possibly can.

You know, we have seen the production tax credit, the benefit that it has provided in terms of jobs, in terms of our rural communities as well where these turbines get sited, the leases that are important there for those farmers in a situation where, you know, we have low corn prices, people are depending on other sources of income often and this is one of them. So in the State of Iowa this has been, I think, a boon in many ways. It has been very beneficial not only for the environmental effects but for the economic effects as well.

And we know what is going to happen to the production tax credit over a 5-year period. I would like to ask Mr. Clemmer, if we had not had the PTC in the past it is difficult to know, but maybe you might have some idea of what that might have done in terms of the jobs that would have been lost. I realize that we would have had other jobs in other parts of the energy industry because we would have electricity coming from other parts of the industry, the energy industry. But do you have any idea what that might have meant in terms of jobs if we had not had the PTC in the past?

Mr. CLEMMER. Yes. Well, generally speaking, I think I can answer that.

Mr. LOEBSACK. Right.

Mr. CLEMMER. You know, one point to make is that as you said Senator Grassley is the father of the PTC passed in 1992, it really did not have much of an effect actually until the early 2000s. And in part it was the combination of the technology improving, it was also due to some of the State renewable standards that got put in place and Iowa was one of the early States that had one of those.

And both of those policy mechanisms, which in a lot of the States these were places that didn't have fossil fuel resources in their State and the economic benefits to them were even greater by fostering those industries, but as I said in my testimony, the effect was by stimulating development when they were in a nascent early phase and then the effects of driving down the cost to make them

more cost effective is what has started to lead to the growth recently and all the jobs that have followed along with it.

And I think if we wouldn't have had—one of the things I said in my testimony and my oral comments was the domestic sourcing of wind turbines has gone from about 20 percent in 2007 to about 50 to 85 percent depending on what part of the technology you are talking about. And that has been a tremendous success story that would not have happened without the PTC.

Mr. LOEBSACK. Right. I have two blade manufacturers in my congressional district, one in Newton and one in Fort Madison. I have a turbine, the structural tower manufacturers in my district as well in Newton, Iowa, and they have been great jobs. They are jobs that you know I hope aren't going to go away. You know, the PTC is going to go away at this point. We will see what happens down the line.

But then on solar as well, I have a lot of hog farmers in my district who are putting solar panels on top of those hog confinement facilities. I don't have the number off the top of my head, but if it weren't for that investment tax credit that wouldn't be happening because we have a matching tax credit in the State of Iowa as well. If we didn't have the Federal tax credit we wouldn't have the tax credit in Iowa. And we can talk all we want theoretically about the distortion of the market and all the rest, but I can tell you there are tangible, positive effects in my State from both the PTC and the ITC, and I am personally glad that we got those extensions on those.

Thank you, Mr. Chair, and I yield back. Thanks to the panel.

Mr. OLSON. The gentleman yields back. The Chair calls upon the gentleman who flew combat missions in F-16 Falcons built in Fort Worth, Texas, Mr. Kinzinger from Illinois, for 5 minutes.

Mr. KINZINGER. It wasn't an F-16, but it was still out of Texas. Well, thank you, Mr. Chairman, and I want to thank you for holding this hearing. Obviously we all recognize we have an opportunity for once in a lifetime, maybe in my lifetime, tax reform, and especially for energy we have to keep in mind that changes can either be a boost or a hindrance and so this is a very important hearing to have.

Mr. Hartman, often the argument is that new technologies need support to scale up and become viable commercially and it often comes from the tax code. How do we determine when a technology has become viable and it no longer needs preferential treatment, in your mind?

Mr. HARTMAN. Well, first off that sort of gets into the infant industry argument. I think that that argument has small shreds of validity, but on the whole I disagree with it as an argument to support a technology in later stage either pre-commercial or early commercial development. I don't find it convincing. However, in this context of saying if we are going to make tax credits more targeted to scale these resources up, typically what we see is that the per unit cost of production is very high at low production levels. And then at a certain point economies, as you ratchet up production you hit economies of scale.

And there are, you know, economic analyses that can be done on various technologies that suggest where economies of scale points

are for a given technology, and thus if we are committed to providing tax credits for infant industries it is better to have an objective criteria like that to help phase those out.

Mr. KINZINGER. OK, so yes, then it is not based just on the politics in the moment, I guess, in terms of when and where. And how have subsidies for renewables negatively impacted other sources like nuclear, for example?

Mr. HARTMAN. That question is for me?

Mr. KINZINGER. Yes.

Mr. HARTMAN. I think that is very region specific, even subregion specific. So, for example, in Illinois, part of what we see is Illinois is a very heavy nuclear State, there is also a lot of wind development, and some of those negative pricing events are contributing factors on the whole. Now I think that sometimes the question of whether a price is negative or it is zero or slightly positive is a little bit blown out of proportion.

I think overall when you look at it we are subsidizing a technology that when it sets price regardless of where it is market prices are below where the competitive levels would be. So, for a technology like nuclear, because there are a lot of transmission constraints at times where these nuclear plants are located, the cost of wind sets the marginal cost, which means its price effect is more pronounced in an area like Illinois than, say, in an area where you don't have a high level of wind production or transmission constraints.

But overall I would stress that the economics of nuclear, especially from independent power producers, is overwhelmingly driven by inexpensive natural gas.

Mr. KINZINGER. And let me ask you too on a bit of a different issue. You discuss how a lack of information and misaligned incentives can cause consumers to underinvest in energy efficiency. Could you elaborate on why that is and some potential solutions to encourage continued investment in energy efficiency?

Mr. HARTMAN. Sure, absolutely. So, from just informational asymmetry perspective, one thing I would point out is that a lot of times in a whole variety of studies, whether this is something like an inefficient furnace consideration or it is, you know, retrofitting homes with more energy-efficient appliances or insulation, usually your everyday consumer doesn't fully understand the net benefits calculation going back. And so there is definitely an information shortage that can lead to suboptimal investment behavior.

Most of the economic literature that looks at that suggests that there is an underinvestment associated with it. My concern with providing tax credits for it is that a lot of those tax credits go to support behavior that would have otherwise occurred in which there is no actual additional behavioral improvement, or in some cases the degree of information deficiency is very, you know, person- or household-specific, and using a blunt instrument like a tax credit doesn't really correct for that deficiency well.

Mr. KINZINGER. OK. With 40 seconds left I will yield back. Thank you.

Mr. OLSON. The gentleman yields back and the Chair wants to take the time to correct his previous comments. My colleague wanted to fly F-16 Falcons built in Fort Worth, Texas.

[Laughter.]

Mr. OLSON. The Chair now calls upon a Texas neighbor, Mr. Green, for 5 minutes.

Mr. GREEN. Thank you, Mr. Chairman and Ranking Member, for holding the hearing, and thank our witnesses for being here. If you can't tell my accent, I am also from Texas.

Since the turn of the 20th century, the United States Government has recognized the importance of energy-related industries in our economy and our national security. It is under this rubric that both conservative and liberal administrations and Congress has offered energy-related industries preferential treatment. As our needs have transitioned, so have fields of power generation and fuel production. At one time, to start up oil, gas, chemical industries required the assistance of the Federal Government and I am proud to say that Texas has benefited.

Now we have new industries that harness the wind, the sun, rivers, oceans, and biomass that will help power the next generation. By the way, Texas produces more wind power than any other State in the country. The truth is, the majority of the investment, tax credits, and directed research has benefited the United States economy and national security. The U.S. economy is the largest and most productive in human history. The free market principles upon which it is founded have created vast sums of wealth that have never been seen before.

However, there are gaps in the system. Basic elementary research and development is not covered by the free market. Initial stages of development are risky and oftentimes not subject to immediate commercializations. Private wealth and investment are not incentivized to take risks on these new industries that haven't been vetted or proved out in some capacity. That is the Federal role, the Government's basic job. The United States Government has funded new industries that have revolutionized our country—hydraulic fracking, alcoholic fuels, and nuclear power. These chemical fuel and power sectors and many, many more have benefited from the tax policy and basic funding and directed research of the U.S. Government.

Rather than pointing fingers let's look forward and focus on where our interests lie and where our money is best spent. There are some cases where incumbent technologies where we can make a big difference like enhanced oil recovery and carbon sequestration and others that may be new, innovative industries like energy storage that would benefit with a little help. The future of U.S. energy will mix traditional and new power generation and fuel production and let's embrace that reality and keep the ball moving forward. I have—thank goodness, my time didn't get taken up.

Ms. Dinan, in current and previous testimony the Congressional Budget Office stated that the basic research and development conducted by the Department of Energy is difficult to quantify. Why are the benefits so hard to calculate?

Dr. DINAN. Well, in general, the reason why kind of the economic rationale for funding such basic research is that it creates what is called spillover benefits and those benefits are very dispersed. So that they could, they are not captured by an individual firm in the form of profits, so you might create some basic knowledge that is

used by various, by a multiple, many different industries and they could be, those benefits could occur over time.

So it is hard to follow the threads from the initial research to capture all of the benefits that flowed from it. So there is a study that people rely on that is fairly old that indicates that the benefits from basic research have more than paid for themselves, but as I said it is very difficult to measure them just by definition of what those benefits are.

Mr. GREEN. Well, if the Federal Government has difficulty in finding the benefits in basic research, it would seem it would be even more so for the private sector because the Federal Government has so many more resources and I guess it, is the private sector inclined to take risk associated with unknown results?

Dr. DINAN. In general, I think the incentives for the private sector to undertake such research gets greater as the technology gets closer to the marketplace because they are more likely to be able to capture that. So that is why we have said in the past that the rationale for government funding of research is much greater when it is very early in the technology process or at the very basic level precisely because firms are less likely to undertake that on their own, but it can create benefits for society as a whole.

Mr. GREEN. Well, I would probably estimate that we wouldn't have developed hydraulic fracking, although there is a lot of folks who did that without some of the tax incentives that the industry would have been able to use. I am not a big one on ethanol because I am from Texas, but we only believe in drinking and eating our corn.

[Laughter.]

Mr. GREEN. But my colleague from Iowa is not here, but they also helped in the creation of ethanol and the research for that. I appreciate your response. My last 13 seconds for the panel, this is for everyone on the panel: Why would we have decided that tax policy is the best means for advancing policy initiatives? Do you want to just go down the—

Dr. MURPHY. Yes, if I understand, I would say it is in that I think that tax policy—if the Government needs to spend funds, then, yes, they have to have taxes to get them, but that they should try to do so without by distorting what would otherwise happen in a market outcome as little as possible.

Mr. HARTMAN. Correct. And I think we have just seen a lot because it is an easier mechanism to implement reform.

Mr. ALDY. Congressman, I would say that you have an array of instruments at your disposal—tax instruments, spending, regulation—and you have to be thoughtful and review and analyze what is the most cost effective way of delivering on your social goals using each of these instruments and accounting for the potential interactions between these instruments.

And you may find that tax policy in some cases may be the most effective way to deliver on our social goals, but in others it may be better through authorizing new activities through the Government through spending or through regulatory actions.

Mr. GREEN. Thank you, Mr. Chairman, for the time.

Mr. OLSON. The time has expired. The Chair calls upon the gentleman from the Commonwealth of Virginia, Mr. Griffith, for 5 minutes.

Mr. GRIFFITH. Thank you very much, Mr. Chairman. I appreciate it greatly. Let me say that yesterday the President signed the executive orders related to energy. From my district which has lost thousands of jobs in the war on coal, his declaration that the war on coal was over and that saved thousands of jobs that would be direct and indirect, but he said the war on coal is over and I am glad to hear that. Unfortunately, in the past many people on the other side of the aisle wanted to say there was no war on coal. They would always cite the price of natural gas, which is true has been a market problem for selling coal, but more important, regulations, et cetera, have been a real problem for us.

And I noted in a political argument on their site yesterday related to the President's executive orders that Brian Deese, former Obama energy advisor, noted that stock prices for coal-related companies are down, underperforming the market by several percentage points, which he sees as a sign that the U.S. economy's transition to cleaner energy sources is firmly enough underway that this administration cannot fundamentally change that dynamic. And that, he argued, is partly because of the Obama team's efforts not only on the regulatory side, but also with respect to research and commercialization, tax incentives, and otherwise. I think it is pretty clear there was a war on coal when your energy advisor can make those kind of comments after the fact.

Now what we want to try to do is come up with a tax policy that makes sense, free market sense, let the market determine where we should go. I believe in all of the above. I think there have been some great things with wind and solar but we have to move forward. Now one of the interesting comments that came up earlier—and I understand there was a dust-up when I was out meeting with constituents a little bit earlier, a dust-up over some of your comments, Dr. Zycher, in regard to backup energy being necessary in the case of renewables.

And I wondered if you wanted to, A, explain what kind of backups are necessary in relationship to renewals, would that also apply to natural gas in certain times of the year in crisis situations? And I understand that the study you were relying on, its accuracy was impugned. If you would like to respond that I will give you this opportunity.

Dr. ZYCHER. Well, I mean, there are two different questions there. One, what are the backup requirements for wind and solar power? You know, I wrote a book on this issue, or on the economics of renewables, about 5 years ago. And my estimate of the cost of backup power given the capacity factor, usage, and the cycling on it was about \$370 per megawatt, and it was really quite striking.

With respect to the pollution effects of renewables combined with the need for their backup power that Mr. Clemmer and I seem to disagree on, he is referring to a bunch of studies that in effect are looking at systems in which the market share renewables is really rather low. It is when renewables approach ten percent or higher in terms of the market share that you start to get this very, very

serious problem with cycling of the backup units up and down and the increased pollution that results from it.

There is simply no question in the Bentek study of Colorado and Texas done about 5 or so years ago and other studies that, once renewable market shares reach about 10 percent, depending on local conditions, the cycling problem results in an increase in the emissions of pollutants, conventional pollutants, and greenhouse gases rather than a reduction, which is not what the clean-energy proponents would have you believe.

Mr. GRIFFITH. All right, I appreciate that. I also thought it was of some interest because—just something I read about a number of years ago that you mentioned, that the Mojave solar project had not produced as much power. I would like for you to touch on that. But also, if you have any knowledge—at the time they were putting that in, there was a real environmental concern that they were going to destroy the ecosystem under the crust of the desert. And if you have any information on that, I would appreciate that, as well.

Dr. ZYCHER. Well, there are no more deserts, there are only fragile deserts. I don't know what fragile means, but any newspaper article, anything that talks about the desert, deserts are always described as fragile. The Ivanpah plant was supposed to produce roughly a million megawatt hours a year starting with its operation about 2 years ago. It has only produced about 650,000 megawatts a year. A spokesman attributed that—and I am not kidding—to some light conditions that were lower than years of studies had suggested to them. That is what they claim, which is a little like the argument from Gosplan on Soviet agriculture. Seventy years of bad harvest were created by 70 years of bad weather. That was essentially their argument.

There actually is, you could argue that there is a statistical distribution of sunlight conditions at any given site and they just happened to get unlucky that the first couple of years they had more clouds than is normally the case. But if you wait enough years, everything will revert to the mean and so they will produce more power. Another theory, which is the one I think is much more likely to be true, is that they overestimated sunlight conditions at the site in order to get the Section 1705 DOE loan guarantee of 1.6 billion, et cetera, et cetera. I don't think that plant is ever going to operate as advertised.

And with respect to your last question, what has happened to the ground beneath the heliostats, I don't know the answer to that. That I have not seen.

Mr. GRIFFITH. All right, and I appreciate that. I yield back, Mr. Chairman.

Mr. OLSON. The gentleman yields back. The Chair calls upon the gentleman from my parents' home State of Vermont, Mr. Welch, for 5 minutes.

Mr. WELCH. Thank you very much, Mr. Chairman. I thank all of the witnesses. It is a timely hearing given the decision by President Trump to roll back the Clean Power Plan. The question of tax incentives is all in the eye of the beholder depending on where you are from if your industry is given an advantage or not, but bottom

line, they seem to be a tool that Congress uses pretty frequently for better or for worse.

I think it is no question that tax incentives affect behavior, whether the outcome is good or bad is always a debate. But my understanding is we have had significant tax incentives for oil and gas production for about a hundred years and it is a very profitable industry. I do believe, and this is a policy question. There is some debate on it in this committee that we do have to move to a much lower carbon footprint in our economy, and I also happen to believe that the more we double down on that effort we can actually create some jobs.

Dr. Zycher, I will ask you. I probably disagree with most of what you say, but I want to ask your opinion as to whether or not there are external expenses associated with carbon fuels that are not priced into the cost of a gallon of gas.

Dr. ZYCHER. If you believe that EPA regulations, as promulgated in coordination with the States, have reduced emissions or have achieved national ambient air quality standards in particular for the six criteria pollutants that protect the public health with an adequate margin of safety, then in that case emissions of those pollutants have been reduced to a level that is efficient in which the marginal cost of reducing them—

Mr. WELCH. All right, yes. But—

Dr. ZYCHER [continuing]. Equals the marginal benefit of doing so. If you don't believe that, fine, then the EPA is violating the terms of the Clean Air Act.

Mr. WELCH. Yes. I don't want to spend too much of my time on this, but I was in Delhi and you couldn't breathe there, and Beijing and you couldn't breathe there, and there is enormous health consequences. I mean, do you dispute that?

Dr. ZYCHER. Do I dispute that there are serious pollution problems overseas? Of course not.

Mr. WELCH. Right. And some of those pollution problems are related to the effects of significant carbon emissions.

Dr. ZYCHER. Sure. Those pollution problems in China and India and, indeed, in Europe are created by policies that do not satisfy U.S. standards.

Mr. WELCH. Let me go on, because I only have 2 minutes, but thank you very much. I am working with Mr. McKinley who is from a coal State, but he and I have an efficiency bill that actually with Mr. Barton we had success getting out of the House several terms ago. But it would provide a rebate for homeowners who demonstrate a 20 percent energy savings, and 40 percent energy savings would get a \$5,000 rebate. That is taxpayer money that is going to make a difference for folks.

Mr. Aldy, do you have any view on that, an approach like that?

Mr. ALDY. Well, I think one important question to ask about how using taxpayer monies for something like this is, What is going to be the incremental impact of that subsidy? And if we think we really are changing people's behavior in a fundamental way, we are getting investment in new energy technologies, that is fantastic. I will note there are a number of States that have programs as well.

And I think this is why as I noted in my testimony and earlier, reviewing the effectiveness of these policies is really important and

it is that transparency on the efficacy of the policy that is really lacking on the tax provisions in contrast to how we address—

Mr. WELCH. And I agree with that. I mean any of us who supported use of the tax code to achieve a result have to be willing to actually calculate what the results are and it can be very expensive, oftentimes much more so than direct investment. And the other issue that is a debate here is regulation because you can overdo it as a regulator and get it wrong.

So I, as a person who thinks that regulation in the right circumstances and properly done is an effective tool to get a policy outcome, am willing to review those regulations to see if it is working. I mean, is regulation a tool that should be used to achieve a policy outcome in your view, Mr. Clemmer?

Mr. CLEMMER. Yes, absolutely. I mean that is, you know, as Dr. Zycher is talking about with EPA, some of the regulations that are in place to reduce SO2 emissions, mercury, that is—

Mr. WELCH. Didn't it really work with SO2? There was not a big cost to the taxpayer, it was regulation that worked?

Mr. CLEMMER. It worked at a much lower cost than what industry was saying for sure because of—

Mr. WELCH. Or mileage standards where we are not micromanaging. It is a challenge obviously, big engineering challenge for the car makers. But if it is a level playing field where the goal is out there and then they are given the freedom to figure out how best to achieve it, that is not costing the taxpayer money but it is achieving a policy of trying to lower gas emissions by increasing mileage.

Mr. Hartman, do you want to comment on that? Then I will yield back, thank you.

Mr. HARTMAN. Sure, so you raised a variety of energy-efficiency policies there. And I think most studies on energy-efficiency policies are very specific to the set of circumstances and that particular policy and what technologies we are looking at. Mr. Aldy referred to some State programs, and I think State programs have done a much more of a drill-down approach to it and I think have revealed that in some cases there are positive net benefits. But in some cases, especially in cases where it gets tied into a mixture of social policy that strays from the original objective function, you tend to see cost well above benefits. I think it is very policy and situation specific.

Mr. WELCH. All right, thank you. Thank you very much.

Mr. OLSON. The gentleman's time has expired. The Chair calls upon the gentleman from Ohio, Mr. Johnson, for 5 minutes.

Mr. JOHNSON. Thank you, Mr. Chairman.

Mr. Hartman, this doesn't directly relate to tax policy, but in your testimony you say that to truly level the competitive playing field and to enhance market performance wholesale electricity market reforms and market enhancing reforms at the FERC level must take place. Can you please elaborate on what those reforms might be?

Mr. HARTMAN. Sure. So I think we can begin with some pending rulemakings that are currently on hold while FERC does not have a quorum at this point. Generally, you want price formation of wholesale electricity markets to fully reflect market fundamentals.

Now because there is a whole variety of very nuanced market failures in electricity systems largely stemming from the need to balance supply and demand instantaneously amongst some other factors, there is a need for the visible hand in terms of the design and the rules of these markets to facilitate the invisible hand of markets to go to work. And so there is a lot of nuanced rules that we need to address. Just to bring up a couple that have been more in the spotlight, I would say the price formation initiative at FERC is a very good example of a well-intended focus to make sure that in this case all short-run marginal costs are incorporated into the pricing structure within the regional transmission operation systems.

Mr. JOHNSON. OK. Well, in your opinion, what should happen first, taking a look at wholesale market reforms or addressing some of the other issues that impact the energy markets outside of FERC jurisdiction like leveling energy-tax preferences and regulatory reform?

Mr. HARTMAN. I think we could, at the risk of biting too much off at the same time, I think we can simultaneously address quite a few. In some cases we see regulatory reform barriers in licensing, whether that is hydro or some of the advanced, you know, modular nuclear reactor designs as well, you know that falls under a very different jurisdiction and set of actors than we see at FERC. So I think it is possible to provide a nudge in all those directions simultaneously.

Mr. JOHNSON. Do you have an opinion on which of these are most pressing in terms of market distortions and why?

Mr. HARTMAN. I think that is a bit challenging to answer overall. The things I would actually stress first and foremost are that we see public policy support competitive market reforms, ones that focus on enhancing market access. So in some cases a lot of these electricity systems were designed around large, central thermal plant generation and what we are seeing with a lot of unconventional technologies becoming more economical is that we don't have a system that fully provides access on a nondiscriminatory basis to all resources in some of these markets.

And so I think that is a good area to approach while making sure we don't cross the road into preferential treatment for these resources and instead make sure we focus on enhancing competitive market outcomes.

Mr. JOHNSON. OK, all right.

Dr. Zycher, understanding the various factors influencing energy markets and predicting how market will respond to tax treatments is very complex and difficult process, so how much confidence should we have in the ability of the tax code to produce a desired outcome?

Dr. ZYCHER. Well, certainly in directionally if you subsidize something you are going to get more of it and the question then becomes how much more and is it worth the cost, and that is something that Congress has to decide. The purpose of the tax code, and I think others have made this point, is to raise revenues while creating, while distorting economic activity as little as possible. If Congress wants to subsidize activity X it really ought to do it on

the spending side of the budget not the tax side, at least in principle.

The narrow answer to your question is it is very difficult to estimate in advance how much a given tax provision will affect the level of a given economic activity. We can get testimony about it, we can experiment, we can see what experience provides, but Congress really has to operate in some degree in the dark when it estimates how much a tax provision will affect the activity that it is trying to encourage.

Mr. JOHNSON. OK. Dr. Murphy, where are the greatest inefficiencies in our energy markets? Is there anything that we have not talked about here this morning that you would like to highlight?

Dr. MURPHY. Well, I think that we have discussed in general all of these aspects, but in particular, yes, I would just say that I would caution policymakers regarding things like the social cost of carbon that even stipulating the physical and science and chemistry and so on, it is not an obvious exercise to go from that to this is the dollar figure that we should then implement in the policy.

So just to motivate it, you asked a hundred physicists how hot is the surface of the sun they are all going to give you an answer that is pretty close. You ask a hundred economists what is the social cost of carbon, the answer is going to be all over the place.

Mr. JOHNSON. Well, in terms of the temperature of the sun, as long as you are close it is not going to matter that much, right?

Dr. MURPHY. Right, right.

Mr. JOHNSON. OK, all right. Thanks a lot. Mr. Chairman, I yield back.

Mr. OLSON. The gentleman's time has expired. The Chair calls upon the acting ranking member of the subcommittee, Mr. Sarbanes, for 5 minutes.

Mr. SARBANES. Thank you, Mr. Chairman. I want to thank the panel. Mr. Aldy, I want to thank you for your testimony today. In your view, have fossil fuel tax subsidies undergone the kind of rigorous scrutiny here in Congress that you think makes sense when you think about the taxpayers' investment on our energy policy or could we do better on that?

Mr. ALDY. I think we could go a lot better on that. I think the fact that they are permanent makes it very difficult to motivate that kind of analysis to get people who have the knowledge and the analytic tools to bring to bear to assess what impacts they have. When we look at what has been done in terms of academic research, we find that those subsidies are for the most part transferring taxpayer monies to these oil and gas companies and to some extent coal companies with very little impact on their production.

Mr. SARBANES. Well, I agree with you. And I have a theory about it, so let me talk for a moment about why I think Congress has not done the kind of heavy lifting on scrutinizing these subsidies that I think it should do. Last election cycle the oil and gas industry alone pumped over a hundred million dollars into Washington, and that wasn't to build a refinery down the street. That went into spending on campaign contributions and lobbying here in DC, and it was done, I think, primarily to protect their special interests.

Now I know we don't have any lobbyists here. Everyone here is an intern, I think, in the audience. But this is a problem. And Dr.

Zycher, you talked about the, quote, ideological and budget maximization incentives of the bureaucracy. I confess I am not exactly sure what you were talking about, but it was elegant phrasing so I wanted to borrow it a little bit and talk about the ideological and profit maximization incentives of the oil and gas industry.

The industry has a huge incentive to pour money into campaign contributions and lobbying and put an army of people up here on Capitol Hill, but it is a very smart investment. I don't blame the industry for doing this. There is a 2014 study out there that estimates that for every \$1 that the fossil fuel industry invested in campaign contributions and lobbying, it got \$59 back when you look at the subsidies that they benefit from here in Washington. That is a 5800 percent return, so it would be crazy for the industry not to invest those kinds of dollars up here in Washington.

But the fossil fuel industry has not just bought its way into a permanent subsidy from the American people, they have bought a whole new discipline over the last few decades of fake science practiced by politicians who deny climate change. The studies show 97 percent of climate scientists agree that climate change is a real threat to the planet; that fossil fuel pollution is a root cause. Eighty percent of Americans want Congress to do something about this.

But we saw what the Trump administration did yesterday and we have seen an inability here in Washington to address the issue of climate change and today we are talking about continuing these permanent subsidies to the fossil fuel industry using American taxpayer money. Mr. Aldy, do you think it makes sense for all the current oil and gas industry subsidies that we have currently in the tax code to be made permanent?

Mr. ALDY. No.

Mr. SARBANES. No. We talk about energy independence, but we need to start talking about how Congress can free itself of dependence on oil industry campaign contributions that have distorted our energy policy for decades. We keep talking about distortion. That word has been used a lot today in relationship to the tax code and whether it distorts or doesn't distort, how we make policy in this country, the judgment and decisions we make. But the huge sums of money that pour into our campaign system from special interest have probably more of a distorting impact on making good public policy than just about anything else.

Now that is our issue. That is our problem here. We have to fix that. We need to build a whole new way of funding campaigns in this country that can free us of the need to turn to special interest. We have got to do it. But if we do that I have absolute confidence that we will have better public policy not just with respect to energy, but with respect to just about everything else. So this is task we have to face. And if we can do it I think we can have smart, thoughtful energy policy for this country that puts the interests of the American people first. And with that I would yield back.

Mr. OLSON. The gentleman's time has expired. The Chair saved the best for last. I recognize Mr. Walberg for 5 minutes, from Michigan.

Mr. WALBERG. I certainly appreciate the chairman's exposé of the best for last, but I think, frankly, I am the most junior member.

It is good to be here, though. And we will go back on to the energy issue. Mr. Zycher, one issue that has been continuously brought to my attention within the tax policy and tax reform debate in this area of energy is the importance of a deductibility of interest expense. Could you please provide some insights on why this is so important to regulated electric and gas companies?

Dr. ZYCHER. Yes. The issue of expensing of capital investments, and therefore to be consistent the elimination of the deductibility of interest expense on the financing for those capital investments, makes a lot of sense everywhere except the regulated utility sector, primarily because regulated ratemaking as accrued generalization uses each year's accounting costs to determine rates that generate a fair and reasonable return.

And so, if a given utility invests in a capital asset, a new generator—pick whatever capital asset you want—and expenses it, then rates in that year will be driven down under what the green eyeshade accounting types call a normalization process, and then the subsequent year it will be driven back up. So, because of the nature of regulated ratemaking, the substitution of expensing in place of the deductibility of interest would create a lot of instability in regulated rates for consumers.

And I think that if Congress in its efforts to adopt a tax reform decides to allow the expensing of capital investments and therefore the elimination of the deduction of interest expense, I think that there needs to be some sort of provision made for the unique circumstances affecting regulated utilities and the ratemaking process.

Mr. WALBERG. OK. Mr. Murphy, what components, I guess continuing on from that what components of the tax code work best for electric and gas companies and their customers, which is important?

Dr. MURPHY. Well, sure. So yes, just to follow on, I think I am coming from a slightly different angle. My position on this matter, so yes, economists they are concerned that right now the income tax, corporate income tax, by allowing the deductibility of interest payments of a company raises money by issuing bonds then they can write that expense off, but not if they issue stock.

And so my point is simply, though, if you got rid of that deductibility but kept it as an income tax, then that means the companies that have a lower net income are getting taxed at a higher rate if they happen to have, be capital-intensive. So yes, it is things like utilities that are very capital-intensive what seems to be an arcane manner of tax policy could have a huge impact.

And as Dr. Zycher was saying, it might get passed on more to consumers because of the way that their prices are set, their ratemaking, and it will show their costs. So I would just caution that if there is going to be tax reform but it is still going to be an income tax to make sure a company is being taxed on its genuine income.

Mr. WALBERG. OK. Mr. Zycher, if utilities are unable to deduct interest costs for infrastructure projects they will ultimately pass these costs along to consumers, they indicate, resulting in higher costs for American families. Do you believe that this rise in electricity prices will have a disproportionate impact on lower income

customers and small businesses? And finally, will this rising cost hurt the global competitiveness of energy-intensive industries like American steel and manufacturing?

Dr. ZYCHER. Well, with respect to lower income individuals and families that depends on the, what an economist would call the income elasticity of demand for electricity and whether or not electricity demands rise less, equal to, or more than proportionate with income and that is not clear. But certainly in the narrow context of those in lower income classes it would be a burden. That is certainly true.

In terms of driving up power prices that would affect competitiveness in international goods markets adversely, that is certainly true as well. I think the major problem is what I mentioned before, the creation of instability in regulated ratemaking over time because of a substitution of expensing in place of the deductibility of interest over time. And I think Congress needs to be very careful about that.

Mr. WALBERG. OK, thank you. I yield back.

Mr. OLSON. The gentleman's time has expired. The Chair wants to announce that the first round of questions is over, it is time for Round 2. I am just kidding. Seeing that there are no further members wishing to ask questions of the first panel, I would like to thank all of our witnesses again for being here today. Before we conclude—

Mr. SARBANES. Mr. Chairman, just ask unanimous consent to introduce these documents into the record: a statement from the American Institute of Architects; comments from Doug Koplow, president of Earth Track, Inc.; written testimony from U.S. Wind, Inc.; a statement from Lake Erie Energy Development Corporation; and a statement by the Biomass Thermal Energy Council.

Mr. OLSON. Without objection, so ordered.

In addition to those statements I would like to introduce a statement for the record from the American Public Power Association; and Matthew Godlewski, the president of the Natural Gas Vehicles for America. And we got the one from the Architects and Earth Track, correct, and Biomass? We are all covered. Without objection, so ordered.

[The information appears at the conclusion of the hearing.]

Mr. OLSON. And pursuant to committee rules, I remind Members that they have 10 business days to submit additional questions for the record, and ask the witnesses to submit their response within 10 business days upon receipt of the questions. Without objection, the subcommittee is adjourned.

[Whereupon, at 12:58 p.m., the subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]



## THE AMERICAN INSTITUTE OF ARCHITECTS

### STATEMENT FOR THE RECORD

#### **“FEDERAL ENERGY RELATED TAX POLICY AND ITS EFFECTS ON MARKETS, PRICES, AND CONSUMERS.”**

House Energy and Commerce Committee  
Energy Subcommittee

March 28, 2017

#### **Introduction**

AIA, the leading professional membership association for architects since 1857, strongly supports comprehensive tax reform that lowers marginal tax rates for individuals, pass-through entities, and corporations, while broadening the tax base and simplifying the tax code.

We recognize that tax reform is a balancing act. Lowering tax rates will require curtailing or dis-carding many tax expenditures, while maintaining and improving a limited number of tax policies that support important policy objectives.

AIA believes that energy efficiency in the built environment is a key policy objective that must be preserved within the context of comprehensive tax reform.

Tax reform is an opportunity to provide taxpayers with much-needed certainty, simplicity, and fairness, while at the same time encouraging economic growth and job creation. With simple reforms outlined below, energy efficiency provisions like IRC Section 179D can meet those needs and more.

Our strong hope is that tax reform results in simple, commonsense tax policies for businesses of all sizes, aimed to spur innovative, economically vibrant, sustainable, and resilient buildings and communities. As the Committee and Congress consider tax reform and its impact on energy markets, prices, and consumers, we urge consideration of the following principles:

- Preserve or extend tax policies that support and strengthen the energy efficient design of buildings;
- Consider tax policies that support economically vibrant, innovative, sustainable, and resilient buildings on a district, regional, or building portfolio scale; and
- Ensure energy efficient and renewable energy building technology is adopted through tax incentives that make this technology more accessible to consumers.

This statement discusses these issues in more detail including policies that support a vibrant built environment, particularly IRC Section 179D,

The American Institute of Architects  
1735 New York Avenue, NW  
Washington, DC 20006  
[www.aia.org](http://www.aia.org)

the Energy Efficient Commercial Building Deduction.

### **The American Institute of Architects**

AIA represents more than 90,000 architects, emerging professionals and allied partners nationwide and around the world.

In 2015 alone, the 18,262 architecture firms owned by AIA members grossed billings of over \$40 billion,<sup>1</sup> driving economic activity and job growth in communities across America. Moreover, most architecture firms at which AIA members work are small businesses, with nearly 95 percent of firms having fewer than 50 employees.

Architects work to advance the public's quality of life through their commitment to healthy, safe, resilient and sustainable communities. From designing the next generation of energy-saving buildings to making our communities healthier and more vibrant and from helping neighborhoods rebuild after disasters, to exporting American design know-how to the rest of the world, architects turn dreams and aspirations into reality.

### **Supporting a Vibrant Built Environment**

As tax reform progresses, it is important to consider tax policies that support innovative, economically vibrant, sustainable, and resilient buildings and communities. To that end, we want to highlight the need to continue and improve tax policies aimed at energy efficiency.

AIA has been working with other design and construction, real estate, and energy efficiency industry members in a coalition of over 100 stakeholders in support of IRC section 179D.

The Energy Efficient Commercial Building Deduction, which is contained in section 179D of the tax code, has been an extremely effective tool in increasing the energy efficiency of buildings. Section 179D has leveraged billions of dollars in private capital, resulting in the energy-efficient construction and renovation of thousands of buildings, while creating and preserving thou-

sands of jobs. It is one of the best examples of the tremendous impact tax incentives can have on financing energy-efficient property. Unfortunately, this provision expired at the end of last year, and has yet to be extended by the current Congress.

Section 179D's success demonstrates the strong need to retain an energy efficiency provision in the tax code in some form. In the case section 179D is retained close to its current form, we strongly urge Congress to make permanent and enhance the section 179D deduction by: (1) ensuring the ability of pass-through entities to capture the full value of an allocated deduction in the case of a public owner of a building; (2) allowing non-profit owners of buildings, similar to public owners of buildings, to allocate the deduction; and (3) increasing the value of the deduction.

### **Allocating the Section 179D Deduction to a Pass-Through Entity.**

Section 179D provides a federal, state, or local government owner of a commercial building an election to allocate the tax deduction to the primary person responsible for designing the energy-efficient enhancements. In December 2010, the Internal Revenue Service (IRS) released a memo that effectively prevents firms organized as partnerships or S corporations from fully realizing the benefit of an allocated section 179D deduction.<sup>2</sup>

In order for partnerships and S corporations to obtain the intended benefits, it is necessary for partners and S corporation shareholders to obtain a basis in their partnerships and S corporations that is not reduced by an allocated section 179D deduction. This issue could be addressed by a simple statutory modification to expressly require the Department of Treasury to issue regulations that properly determine partnership or S corporation outside basis in the case where section 179D is allocated. Such a clarification would provide certainty and address a widespread concern among many small businesses that design energy-efficient buildings.

#### Allocating the Section 179D Deduction in the Case of a Non-Profit Owner of a Building.

In many cases, non-profit entities, such as hospitals, universities, private schools, charities, and foundations, conduct functions similar to state and local governments. Currently, non-profit entities own thousands of properties across the country. Although retrofits to these properties could result in significant energy savings, the non-profit entities do not pay taxes and, consequently, cannot benefit from section 179D.

The section 179D allocation provision should be expanded to provide non-profit owners of buildings, similar to public owners of buildings, with the ability to elect to allocate the deduction to the primary designer of the building. Such a provision would assist non-profits in financing energy-efficient upgrades and would reduce their energy costs in the longer-term.

#### Enhancing the Section 179D Deduction.

The maximum section 179D deduction of \$1.80 per square foot has not been increased since the deduction was put in place in 2005 and, as a result, has not kept pace with inflation. Consequently, the impact of section 179D has become diminished over time.

Increasing section 179D from the current maximum allowable amount of \$1.80 per square foot to \$3.00 per square foot for buildings that hit reductions of 50 percent beyond ASHRAE 90.1 2007, would increase the deduction's effectiveness. In the case of individual subsystems, the maximum allowable deduction should be increased from \$0.60 per square foot to \$1.00 per square foot.

Enhancing section 179D would provide an important source of additional capital to stimulate building design, construction, and renovation, driving the creation of well-paying jobs. An enhanced 179D deduction would further incentivize energy efficiency, improve the nation's commercial building stock, and increase energy independence.

#### A New Approach to Energy Efficiency Tax Policy

In its current form, the Internal Revenue Code (IRC) contains a number of important tax provisions that impact the energy efficient design and construction of buildings, in addition to Section 179D. These include policies such as the Residential Energy Efficiency Property Credit (IRC § 25D), and the New Energy Efficient Home Credit (IRC § 45L), both of which expired at the end of last year.

Each of these provisions provides important support for the design, construction, and renovation of buildings of different types. However, the complexity of the tax code, inconsistency in the requirements and metrics of differing provisions, and a lack of policy coordination between them often blunts their impact. As AIA's 2010 study *Promoting Livable Communities* notes:

*There are hosts of tax policies that impact real estate generally. However, because there was no overarching federal vision for livability at the time of their development, the incentives tend to address single pieces of the larger picture and have a strong focus on individual buildings, making it difficult for communities and developers to use the tax policies to create livable, sustainable patterns of development.*

Tax reform presents the opportunity to review these policies, identify important policy objectives, and develop and improve tax policies that empower building owners and their communities to achieve these objectives. In the case of energy efficiency, there is an opportunity to take all of these provisions and create a single, technology neutral energy efficiency provision that could possibly address efficiency on the district, regional or building portfolio scale.

Instead of a piecemeal approach to reforming these provisions among others, we encourage the committee to view the built environment holistically, and re-envision tax policies that encourage new and existing property improvements benefiting the community and environment at large, on a macro level.

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AIA is currently working with members of the House Ways and Means Committee and the Senate Finance Committee to develop technology neutral energy efficiency tax incentive proposals that address the policy goals enumerated above. AIA will keep House Energy and Commerce, Energy Subcommittee members and staff apprised of these developments and will circulate policy drafts among members and staff once completed.

**Conclusion**

As Congress considers tax reform, we urge the preservation and reform of tax policies that support innovative, smart, energy-efficient, and resilient development. Tax reform following these principles would provide taxpayers with much-needed certainty, simplicity, and fairness, while at the same time encouraging economic growth and job creation.

AIA and its members are ready to serve as a resource to Congress and the Committee on these and other issues.

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<sup>1</sup> AIA, *The Business of Architecture: 2015 AIA Firm Survey Report* (2015).

<sup>2</sup> I.R.S. Chief Couns. Mem. AM2010-007 (Dec. 23, 2010).



Subcommittee on Energy of the  
Committee on Energy and Commerce

*Hearing on*

***Federal Energy-Related Tax Policy and its  
Effects on Markets, Prices, and Consumers***

March 29, 2017

*Comments of*

Doug Koplou  
President  
Earth Track, Inc.

Chairman Upton, Ranking Member Rush, and members of the Subcommittee, thank you for the opportunity to provide input on the impact of government subsidies on energy markets, prices, and consumers.

For more than 25 years, I have analyzed subsidies to energy on behalf of non-governmental organizations and international agencies. This work has included identification and review of subsidies to particular fuel cycles at the state, national, and international level; evaluation of the commonly applied subsidy valuation approaches around the globe; and peer review of scores of energy subsidy-related reports and academic papers.

Within the United States, the cost of energy subsidies to taxpayers is both substantial and often not properly documented. Regular review to evaluate the fiscal costs of these policies; their impact on market structure, competitiveness, and environmental quality; and their ability to achieve stated goals is prudent.

My comments focus on three main issues:

- **All subsidy mechanisms matter.** In order to optimize energy subsidy policy, one needs to look at all mechanisms the government is using to transfer value to market participants, not just tax subsidies.
- **Subsidies to conventional fuels are often more difficult to quantify than those to renewables, but are nonetheless large and long-standing.** Production tax credits, cash grants, and purchase price premiums comprise the majority of government support to large renewable resources such as wind and solar. These interventions are easier to quantify than the credit or risk subsidies, state ownership, lease competitiveness, or upstream tax breaks that dominate the subsidy picture for conventional fuels. Ignoring these more complex instruments, however, will produce a skewed view of government interventions over time and impede development of an optimal reform strategy.
- **Simple changes to policy structures can greatly improve subsidy efficiency and transparency.** There are more and less distortionary ways to provide subsidies to targeted activities. Where subsidy elimination is not possible, reforms can and should restructure both existing and new subsidies to ensure that more efficient approaches are used.

**1) All key support mechanisms must be evaluated to properly assess the market, environmental, and fiscal impacts of energy subsidies**

The current policy push for tax reform aside, the federal government provides subsidies to energy producers and consumers in many different ways. These include direct spending; credit subsidies such as loan guarantees and direct loans; liability transfers such as subsidized insurance or artificial caps on private liability exposure; purchase mandates that require markets to consume particular forms or quantities of energy even at above-market prices; and direct state ownership of particular supply chain functions. Because some forms of energy have larger environmental impacts during extraction or consumption, regulatory exemptions can allow damages (negative externalities) to go unchecked, creating a competitive hurdle for cleaner alternatives and an unjustified market advantage for the more polluting fuel.

A summary of the common ways governments intervene in energy markets is shown in Table 1 below.

It is notable that interventions can act as a subsidy in some situations and as a tax in others, depending on policy details or ones position in the marketplace. Non-competitive leasing arrangements subsidize producers, but can result in losses to landowners (including states and tribes). Purchase mandates, such as the federal Renewable Fuel Standards for ethanol and biodiesel, reduce costs for energy producers though largely by shifting them to fuel consumers. Many excise taxes on fuels are earmarked for particular purposes (e.g., highway construction, reclamation of abandoned mine lands). If they are set too low (as they usually are), a residual subsidy remains.

Including multiple mechanisms in energy subsidy evaluations is the norm around the world. Though agreement on the exact definition of an energy subsidy is not universal, there *is* universal consensus that a wide mixture of policy types is relevant in assessing subsidy scope and magnitude. The subsidy definitions, policies, and/or analyses conducted by the World Trade Organization (WTO 1995), the G20 (G20 2009 and US Government 2016), Asia-Pacific Economic Cooperation (APEC 2009), the World Bank (2010), the International Monetary Fund (Coady et al., 2015a), the Organisation for Economic Cooperation and Development (OECD 2011, 2015), and the International Energy Agency (2016) all highlight this basic point. So, too, do reviews of US federal energy subsidies by the Energy Information Administration (EIA 2015a), the Government Accountability Office (GAO 2007, 2013), and the Congressional Budget Office (CBO 2015) – all of which address much more than just tax subsidies. My hope is that this subcommittee will do so as well.

**Table 1. Governments transfer value to the energy sector in many different ways**

Intervention category	Description
<b>Direct transfer of funds</b>	
Direct spending	Direct budgetary outlays for an energy-related purpose
Research and development	Partial or full government funding for energy-related research and development
<b>Tax revenue foregone</b>	
Tax*	Special tax levies or exemptions for energy-related activities, including production or consumption; includes acceleration of tax deductions relative to standard treatment
<b>Other government revenue foregone</b>	
Access*	Policies governing the terms of access to domestic onshore and offshore resources (e.g., leasing auctions, royalties, production sharing arrangements)
Information	Provision of market-related information that would otherwise have to be purchased by private market participants
<b>Transfer of risk to government</b>	
Lending and credit	Below-market provision of loans or loan guarantees for energy-related activities
Government ownership*	Government ownership of all or a significant part of an energy enterprise or a supporting service organization; often includes high risk or expensive portions of fuel cycle (nuclear waste, oil security, or stockpiling)
Risk	Government-provided insurance or indemnification against accident or operating risks, at below-market prices
<b>Induced transfers</b>	
Cross-subsidy*	Policies that reduce costs to particular types of customers or regions by increasing charges to other customers or regions
Import or export restrictions*	Restrictions on the free market flow of energy products and services between countries
Price controls*	Direct regulation of wholesale or retail energy prices
Purchase requirements*	Required purchase of particular energy commodities, such as domestic coal or biofuels, regardless of whether other choices are more economically attractive
Regulation*	Government regulatory efforts that substantially alter the rights and responsibilities of various parties in energy markets or that exempt certain parties from those changes. Distortions can arise from weak regulations, weak enforcement of strong regulations, or over-regulation (i.e., the costs of compliance greatly exceed the social benefits)
<b>Costs of externalities</b>	Costs of negative externalities associated with energy production or consumption that are not accounted for in prices; examples include greenhouse gas emissions and pollutant and heat discharges to water systems
* Can act either as a subsidy or as a tax depending on program specifics and one's position in the marketplace.	
<b>Sources:</b> Koplou (1998); Kojima and Koplou (2015). Main section headings from OECD (2011).	

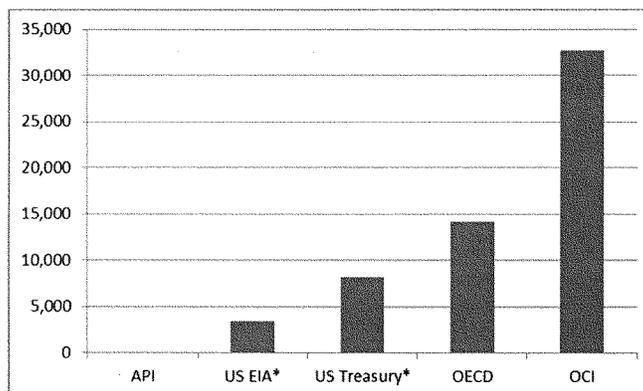
The most important subsidy mechanisms can vary across energy types. For example, credit subsidies, liability caps, and state ownership (for nuclear waste management) are important subsidies for nuclear power. Purchase mandates are very significant for renewable transport fuels such as ethanol and biodiesel. Tax breaks, royalty reductions, lease auction formats, and subsidies to linking infrastructure (often at both the state and federal levels) are important for domestic fossil fuel production and transport.

Inconsistent or incomplete capture of the full range of subsidy types is a major contributor to dispersion in estimates. Three main factors are at play: the adoption of different subsidy definitions (sometimes politically driven) that exclude relevant supports; limited research scope (a perennial challenge with EIA's periodic subsidy reviews), data access, or valuation challenges that reduce coverage for policies recognized as conferring subsidies; and changes in how often a particular subsidy is claimed by market participants year-to-year (subsidy "uptake") due to shifts in market prices, eligibility, or technical changes in production methods.

Using the example of US fossil fuel subsidies, Figure 1 illustrates how significant this dispersion can be – with estimates ranging to from zero to more than \$30 billion per year. The zero value was put forth by the American Petroleum Institute, the largest trade association for the oil and gas industry (Comstock 2014). Although it can be dismissed on technical grounds, the politics remain central and affect the ability to institute rational reforms. Large budgets enable their viewpoint to be promoted heavily, even permeating the recent confirmation hearings for Secretary of State Rex Tillerson (see Koplou 2017).

The data year is a contributing factor to variance on the remaining estimates (due to changes in subsidy uptake), as is the inclusion of some state-level tax breaks in the OECD and OCI estimates. However, differences in how well a study covers all mechanisms of support also matters. Think tanks that receive large amounts of funding via the fossil fuel industry tend to focus only the lowest estimates, in this case produced by the EIA. However, the EIA research scope is set by the requesting members of Congress and has contained important gaps in the past (see Koplou 2010). Many of these scoping issues are now clearly presented in EIA's release materials (EIA 2015b). Evaluating a mix of studies is helpful in ensuring adequate policy coverage.

**Figure 1. Estimated US subsidies to fossil fuels**  
(Millions USD/year)



Sources: Comstock (2014); OCI (2014); EIA (2015a); OECD (2015); United States (2015).

Notes:

\* Federal subsidy estimates only; no sub-national data in totals.

Data years: 2013 (EIA, OCI); 2014 (OECD); average projected 2016-25 (US Treasury).

Figure 2 provides another window on the coverage gap problem. All of the estimates are dominated by tabulated subsidies from direct spending and tax breaks. Only Oil Change International (OCI) captures any values for subsidies to mineral access and state owned infrastructure. Shortfalls in reclamation fees, caps on oil spill liabilities and fairly extensive regulatory exemptions (see Kosnik 2007) are not captured at all.

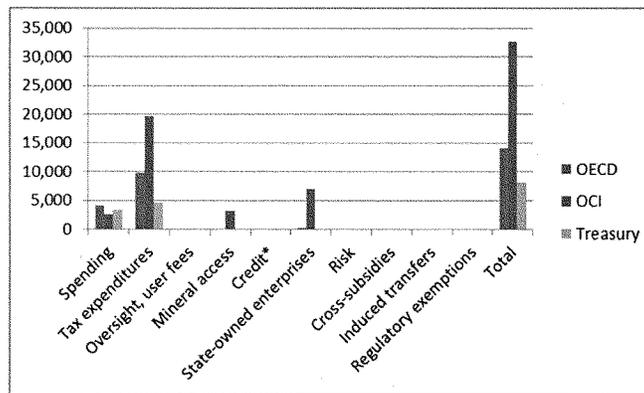
Nor are some other very large potential supports to fossil fuels that can be important considerations when thinking about the longer-term energy path of the country. The IMF, for example, estimated that state and federal consumption taxes on fossil fuels in the United States are lower than those on other goods and services by \$45 billion per year (Coady et al., 2015b).

Defense spending to protect oil supply security is another area not picked up in any of these estimates. Stern (2010) analyzed long-term trends in defense spending as well as ex-region support costs for the Persian Gulf force projection. Using detailed budget information and an activity-based costing approach, he estimated the average annual cost of the Persian Gulf mission at more than \$200 billion. Though he did not attribute a specific portion to oil, the spending base is so high that any reasonable cost sharing with the historically-significant oil

mission would constitute material support to oil. Interestingly, the Persian Gulf oil security costs are funded by US taxpayers, though benefits accrue to oil suppliers and consumers in Europe and Japan as well. Recovering this cost via an excise fee on shipments would help to encourage increased supply diversification (Koplow 2015).

The goal of these comments is not to resolve all of the data disparities, but merely to call attention to the need for more systematic review of federal policy to support Congressional reform efforts.

**Figure 2. Coverage disparity across subsidy types, US fossil fuels**  
(millions USD/year)



**Notes:**

\*Insufficient data to calculate credit subsidies. Face value of commitments to fossil fuel projects in 2013 were about US\$4.5 billion/year (OCI, 2014).

Data years: 2013 (OCI); 2014 (OECD); average projected 2016-25 (US Treasury).

**2) Energy subsidies are significant even for conventional fuels**

While other testimony submitted for this hearing will likely focus on subsidies to renewable energy, it is important to note that subsidies to conventional fuels in the United States are also large, and have been in place for much longer. A detailed review of federal subsidies to all fuel cycles I conducted for base year 1989 is illustrative: conventional energy resources (fossil, nuclear and large scale hydro) received eight dollars in subsidies for every one

supporting renewables; and energy supply received 35 dollars in subsidies for every dollar supporting end-use efficiency (Koplow 1993).

While patterns today are not quite so skewed, the continuing significance of government support both to fossil energy and nuclear can be seen below.

**a) Nearly half of the proven, but not-developed, US oil reserves are subsidy dependent**

A recent paper prepared with the Stockholm Environment Institute modelled the impact of key subsidies on the investment returns at more than 800 domestic oil fields (Erickson, Down, Lazarus and Koplow 2017). The assessment focused primarily on federal tax breaks, though also evaluated some non-tax federal supports and state-level subsidies in Texas and North Dakota. The analysis utilized detailed data on reserves and field economics developed by Rystad Energy.

The results are summarized in Table 2. Across the US, 45 percent of these discovered, but not yet producing, reserves, were dependent on subsidies in order to meet their minimum economic hurdle rate. The subsidy dependency ratio jumps to nearly three quarters for the offshore Gulf of Mexico due to the higher costs of operating there. It is notable that this high subsidy dependency value in the Gulf region was based on our prospective review, and excluded the billions in subsidies granted to producers via the Deep Water Royalty Relief Act of 1995 (GAO 2007).

Without subsidies, nearly 20 billion barrels of oil-equivalents across the country would have remained in the ground. For many industries, tipping projects from uneconomic to investable and productive generates only positive outcomes; think new medications that fight difficult diseases, for example. Fossil fuels are different. The subsidies do generate economic activity and jobs, but they also increase the negative environmental impacts from extraction and consumption and production expands.

Our assessment indicated the subsidy-dependent fossil fuels would result in an additional 8.1 Gt of CO<sub>2</sub> being released. The Intergovernmental Panel on Climate Change (IPCC) has estimated that if society is going to maintain even a two-thirds chance of limiting warming to the internationally agreed goal of 2°C (Clarke et al. 2014), net global emissions from 2016 onward cannot exceed 840 Gt CO<sub>2</sub>. In that context, the decision by the U.S. federal and

state governments to continue subsidizing these investments would produce oil that, once burned, will produce CO<sub>2</sub> emissions equivalent to about 1% of the remaining global carbon budget available to *all sectors of all economies* (Erickson, Down, Lazarus and Koplow 2017).

Economies are dynamic, of course; and a drop in US production would in part be met with increased imports from abroad – particularly if these other nations continued to subsidize their own fossil fuel production. Yet even after adjusting for imported fuels, the US subsidies are still driving a *net* increase of 1.5 Gt of CO<sub>2</sub>.

**Table 2. Impact of subsidies on undeveloped oil resources and GHG emissions (at \$50/bbl)**

Area	Economic oil resources, discovered but not yet producing (billion barrels)	Percent subsidy-dependent	Increase in economic oil resources due to subsidies		Increase in net GHG emissions (Gt CO <sub>2</sub> )
			(billion barrels)	(Gt CO <sub>2</sub> )	
Williston basin	4.1	59%	2.4	1.0	0.2
Permian basin	20.3	40%	8.0	3.3	0.6
Gulf of Mexico	2.1	73%	1.5	0.6	0.1
Rest of U.S.	16.7	46%	7.6	3.1	0.6
<b>Total U.S.</b>	<b>43.3</b>	<b>45%</b>	<b>19.6</b>	<b>8.1</b>	<b>1.5</b>

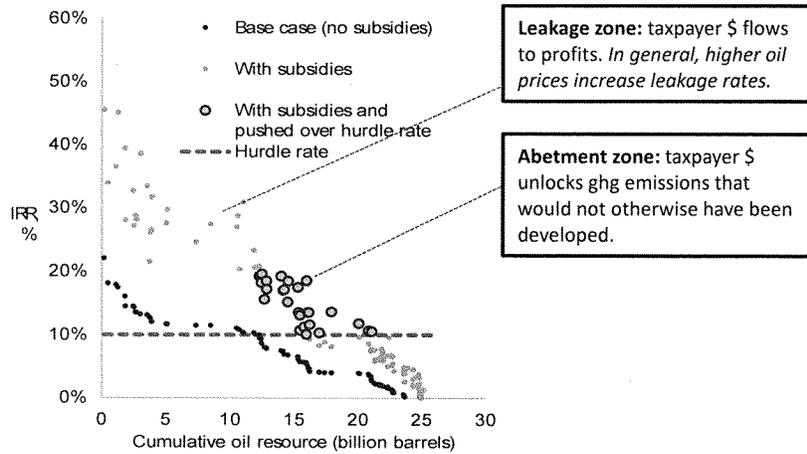
Source: SEI analysis based in part on data from Rystad Energy, in Erickson, Down, Lazarus, and Koplow (2017).

The impacts of these subsidies on individual oil fields can be seen more clearly in Figure 3 below, which illustrates three general categories of projects for the Permian Basin. The first category contains fields that are too expensive to develop at today's prices even with subsidies. The second category are fields that are highly profitable even with no government interventions, and for which taxpayer supports simply boost the economic returns "leaking" to resource owners or production companies in the form of higher profits. As leakage associated with a particular subsidy grows, the policy benefit to keeping it in place declines. This is why some subsidies are structured to phase out (albeit imperfectly) as market prices rise.

Where subsidies tip a project from low returns to investable, the subsidies are triggering incremental economic activity in the subsidized sector. From an environmental perspective, the subsidies work against carbon abatement, and instead abet increased emissions.

Our analysis assumed market prices of \$50/barrel of oil, roughly in line with current prices. In general, higher commodity prices will make fewer wells dependent on subsidies to be economic. This same trend will mean that more of the taxpayer support simply leaks to producers as higher profits. At prices lower than \$50 per barrel, the subsidy dependency rises as does the impact of those subsidies on greenhouse gas emissions.

**Figure 3. Effect of subsidies on project economics at \$50 per barrel, for fields discovered but not yet producing – Permian Basin**



Source: Erickson, Down, Lazarus, and Koplow, 2017

**b) Subsidies to the nuclear fuel cycle have often exceeded the value of power produced**

A 1954 advertisement that General Electric placed in *National Geographic* magazine about nuclear power stated that “We already know the kinds of plants which will be feasible, how they will operate, and we can estimate what their expenses will be. In five years – certainly within 10 – a number of them will be operating at about the same cost as those using coal. They will be privately financed, built without government subsidy.”

More than sixty years later, the nuclear power sector remains as dependent on government subsidies as ever. This is a global issue, not US-specific despite industry claims about low cost reactor delivery elsewhere. The economics of nuclear are somewhat less murky in the United States than in other large nuclear countries like China or Russia where state involvement and ownership pervades nearly every segment of the fuel cycle.

But even here, the subsidy picture is challenging to piece together – evident in the fairly large spread between high- and low-subsidy estimates in Figure 4 below. The chart summarizes the findings from a detailed review of subsidies to the nuclear fuel cycle that I did for the Union of Concerned Scientists in 2011 (Koplow 2011). Quite often, the subsidies exceeded the value of the power produced.

Figure 4 divides subsidy levels by time period and ownership type. The subsidies available for reactors built in the 1970s and 1980s are not the same as the policies in place today; and for operating reactors, some of the original subsidies to capital are no longer affecting the cost structure of the facility. Similarly, taxable investor-owned utilities and tax-exempt public utilities did not receive the same subsidies either. Many reactors are owned by multiple parties and can include fractional ownership from both groups.

The federal policies in place today have remained fairly constant since this analysis was done. The nuclear production tax credit is nearing expiration, though most people expect it will be extended at least to apply to the US reactors now under construction. The major differences since 2011 is that the prospects for new nuclear projects have dimmed considerably, and that existing reactors are being outbid in competitive power markets and begging for massive new subsidies at the state or public utility commission level.<sup>1</sup>

The major drivers of these changes include the Fukushima accident, poor performance around the world of both new build projects and even operating reactors (with sizeable shutdowns in France), and continued pricing pressure in the US primarily from fracked gas.

Tax subsidies are relevant to US nuclear energy, though less so than other forms of support. Tax preferences include a lower tax rate on investment earnings from trust funds established to pay for future plant decommissioning, and production tax credits for new reactors. Uranium mining has long received percentage depletion benefits, though the related tax expenditures have been immaterial. In decades past, utility investments, and nuclear in particular, received generous investment tax credits. Interest incurred during the construction of reactors could also be deducted from taxable income rather than capitalized (Koplow 1993).

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<sup>1</sup> Subsidies in New York are perhaps the furthest along, and estimated to cost nearly \$8 billion; a similar approach nationally would generate more than \$150 billion in subsidies to nuclear between now and 2030 (Judson 2016).

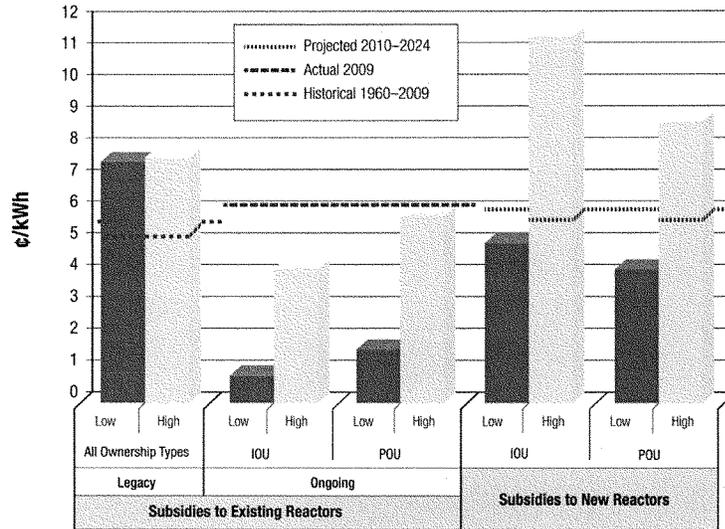
But non-tax forms of support were, and continue to be, critical. Long-tail risks that are difficult to predict but can escalate sharply over time cause heartburn for investors, leading them to withdraw funding or escalate minimum return requirements. It is hard to find a longer-term obligation than the management of high-level radioactive waste. These risks have been nationalized in return for a small fee, in effect removing it as a long-term investor concern.

Accident risks are another area where a low-probability but very high impact exposure has been shifted to the public. Capped under the Price-Anderson Act more than sixty years ago, the industry claims it has no subsidy value yet fights like crazy to ensure it is renewed. Uranium enrichment was state-owned in the US for much of the industry's history (Koplow 1993, 2011) and most capacity even today remains government-owned, albeit not by the US government (Koplow, forthcoming).

Very large capital costs for new reactors, combined with a history of long delays and large cost overruns, have rightfully led capital providers to be quite wary of new reactor projects. As a result, credit support, pre-funding of capital costs by ratepayers (via favorable construction work in progress, or CWIP, rules), and take-or-pay contracts for customers even if costs rise and power is late, are key drivers of the handful of new reactors now being built in the country. These policies are a mix of federal and more local subsidies, though it is always the combined effects that drive market distortions.

At the federal level, credit support has been particularly important. While the \$535 million loss on the Department of Energy's loan guarantee to the Solyndra solar project has gotten tremendous attention, its \$8.3 billion loan guarantee (DOE 2015) to new nuclear reactors at Plant Vogtle in Georgia seem to get mostly overlooked – despite being more than fifteen times as large. Westinghouse Electric, Inc., Toshiba's US nuclear unit that was in charge of building the Vogtle reactors, is expected to declare bankruptcy next week (Hamada and Fuse 2017). The *Japan Times* (2017) noted sources "close to the matter" indicated that taxpayer costs due to the bankruptcy were likely.

Figure 4. Nuclear Subsidies Compared to EIA Power Prices



Note: Legacy subsidies are compared to the Energy Information Administration (EIA) average 1960–2009 industrial power price (5.4 €/kWh). Ongoing subsidies are compared to EIA 2009 actual power prices for comparable busbar plant generation costs (5.9 €/kWh). Subsidies to new reactors are compared to EIA 2009 reference-case power prices for comparable busbar plant generation costs (5.7 €/kWh).

Source: Koplów (2011).

### 3) Making subsidies more efficient

Long-term competitive dynamism can often provide a more robust, effective, and efficient impetus for energy market innovation than would federal subsidies of any type. Too often, even policies with noble intent become politicized once they wind their way through the Congressional process. Forcing key market signals with respect to technical, market, and safety risks; delivery reliability; and cost through into end-user prices should be a key goal.

Achieving accurate price signals necessarily includes proper recognition of negative externalities such as pollution, and the implementation of corrective measures such as pollution taxes, credits, or regulatory limits on emissions. Although the current administration seems intent on unrolling many of these controls, gains to industry will likely be short-lived and accrue to well-connected industry incumbents. Because many other countries will continue to

enforce environmental regulations, their industrial base will continue to evolve to be less polluting and more energy-efficient. This could cause longer-term problems for the US. There are indications that prudent regulations have fairly small short-term impacts on jobs and competitiveness, and benefits over the longer-term (see, for example, Dechezleprêtre and Sato 2014).

Where Congress determines government subsidies are appropriate, it is incumbent on members to deploy them more efficiently and dynamically. This issue is discussed below.

#### **a) Limiting subsidy exposure**

A variety of techniques have been used, though not consistently, to limit taxpayer financial costs from energy subsidies and to reduce subsidy leakage. Pre-set expiration dates (sunsetting) is common with most renewable energy tax breaks, and to legislatively-mandated programs such as the Price-Anderson Act. However, many subsidies, including many tax subsidies to fossil fuels, lack expiration dates.

Capping the dollar value or eligible production capacity eligible for particular subsidies is fairly routine at the state level (where budgets are smaller), and also sometimes deployed at the federal level (the nuclear production tax credit, for example). New facilities may also be limited to a specific time period over which they can receive subsidies, ensuring that taxpayer exposure does not continue long after initial capital investments have been paid off. These constraints do make a difference. Of the wind power capacity built between the inception of the wind PTC in 1992 and 2016, nearly 60% of cumulative capacity will have aged out of PTC eligibility by 2018, and nearly two-thirds by 2020.<sup>2</sup>

Price-triggers are also a useful tool, increasingly put into subsidy language so the subsidies decline or drop to zero during favorable market conditions for producers. This should also be standard. Ironically, some existing provisions work the opposite direction. Percentage depletion allowances, for example, are based on the market value of the extracted commodity. As a result, the subsidy value can surge just when it is needed least.

#### **b) Subsidy duration should be long-enough to encourage innovation, but have pre-set stepped phase-outs**

Setting the parameters to limit subsidy duration and cost needs to balance the ramp-up time needed to develop new technologies or industries with a fast-enough phase-out to avoid

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<sup>2</sup> Earth Track calculations based on AWEA (2017).

the subsidy being treated by recipient industries like it is a property right. As shown in Table 3, many significant subsidies to energy have not met this balance. At one end of the spectrum, frequent lapses in enabling legislation followed by short renewal periods creates unpredictable investment signals and impedes development of a strong domestic industry, particularly for sectors requiring capital-intensive investments. The production tax credit for wind power has followed this pattern: though mostly in effect since 1992, the tax credit has lapsed and been renewed ten times during this period.

In contrast, although it has been somewhat narrowed over time, the expensing of intangible drilling and development costs for oil and gas producers is more than a century old. Other subsidies to oil and gas are nearly that old as well, some of which were controversial quite early on: the Joint Committee on Taxation launched an investigation into the percentage depletion allowance for oil in 1927 (JCT 1927). While the world was different a century ago, these provisions should now all have expiration dates.

Most expiring tax provisions have a “bright line” date where they drop immediately to zero unless otherwise extended. Particularly for subsidies intended to spur development of new industries that can eventually compete on their own, it makes more sense to have a pre-set, but phased and difficult to extend year-after-year, decline in subsidy levels as a way to transition the industry to full competition. This approach is being used with the termination of the wind production tax credit, phasing down by 20 percent per year until it is gone.

**Table 3. Too many subsidies don’t expire**

Provision (type)	First Implemented
<b>Oil and Gas</b>	
Expensing of intangible development costs (tax)	1913; narrowed over time, but no expiration.
Percentage depletion (tax)	1926; narrowed over time, but no expiration.
Expensing of geological and geophysical costs (tax)	1933; narrowed over time, but no expiration.
<b>Coal</b>	
Percentage depletion (tax)	1932; no expiration.
Excise tax for abandoned mine lands (user fee)	1977, but multi-billion dollar backlog.
External trust funds for reclamation (regulatory)	Never; recent coal mine bankruptcies create significant liability risks for taxpayers.
<b>Wind and solar</b>	

Provision (type)	First Implemented
Production tax credits (tax)	1992, with sunset in ~7 yrs; lapses and 10 short-term renewals to date.
<b>Nuclear power</b>	
Government-funded research and development (direct spending)	Data back to 1948; nuclear captured 73% of federal energy R&D spending through 1977; and 49% for the period 1948-2012.
Price-Anderson cap on nuclear accident liability (risk)	1957, with multiple extensions since then (presently through 2025); reactors and fuel cycle facilities covered for their operating life even if Act isn't renewed.
Nationalization of responsibility to manage high level nuclear waste (state ownership)	1982; all technical and management risks rest with the federal government. In theory, financial risks can be shared via increases in fees on industry; in practice, these plants will be closed well before critical cost and performance problems are evident.
External trust funds for decommissioning (regulatory)	1984; tax-favored investments and some risk of underfunding, but more secure than the post-closure funding available in most other countries.
Federal loan guarantees (risk)	2005; \$8.3 billion authorization for nuclear (Vogtle Plant) in 2014-15; by far the largest project. An additional \$12.5 billion to advance nuclear remains available.

**c) Policies that keep development and delivery risks in the private sector should be preferred**

If subsidies are to be provided, doing so in a manner that costs taxpayers nothing if the project or investment fails to meet the policy objective for which the subsidy was created should be strongly preferred.

For example, a production tax credit costs nothing if a plant is never built. If it is built, but doesn't work properly, costs will be lower as a result since output is below target. In stark contrast, the large federal loan guarantees to the Vogtle reactors under DOE's Title XVII program work in exactly the opposite direction. They will cost taxpayers billions of dollars if the plant is never completed. If it is completed and successful, the taxpayers who fronted the credit risk will have no share of the plant's upside. This system of socialized risks and privatized profits is among the poorest subsidy structures.

Government-provided loans and loan guarantees may also introduce political pressures and selection bias regarding which projects are chosen, both of which increase the change of suboptimal loan performance. The alignment of incentives between the funder and the project

is nearly impossible: long-term funding decisions for very large financial commitments are made by people with a relatively short expected job tenure and no personal exposure to investment performance, good or bad. As an illustration of this issue, the people who ran DOE and DOE's Office of Loan Programs while the Vogtle application was being evaluated and approved are gone.

**d) Governments should be neutral with respect to how to meet a particular energy goal, and aim to allocate subsidies by competitive tender rather than political fiat whenever possible**

Recipient industries will almost always favor subsidy carve-outs: for their industry, their technology, or their region. Politicians may favor these as well, in order to better target support to constituent interests. The exact opposite process is usually needed to achieve particular policy objectives efficiently and dynamically.

Consider the example of a justifiable interest that the US to diversify our transportation fuels away from a singular dependency on petroleum. Rather than have individual policies for a range of specific alternative fuels and vehicle drive trains, a competitive process to allocate the pool of subsidies to providers able to provide reduced petrol consumption per vehicle mile most quickly and at the lowest subsidy cost would make more sense.

If there is a policy interest in ensuring a handful of contending approaches, a tender process could have more than one winner. But rather than having the government trying to differentiate which providers are in the "leakage zone" (Figure 3), they would self-identify through the bidding process, reducing the subsidy cost to achieve the policy goals.

The important structural points would be that (a) the competitors must bid against each other for the lowest subsidy per unit delivered (as happens with many auctions to meet Renewable Portfolio Standard targets); (b) that these bids be redone every few years to ensure that unit subsidies fall as technical and other efficiency improvements bring down costs for producers; (c) that allowable bidders include the demand side and efficiency options, not just increased supply; and (d) that subsidy payments be distributed incrementally as services or products are delivered to ensure the taxpayer does not incur costs if the bidder fails.

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Lake Erie Energy Development Corporation  
Statement for the Record

House Committee on Energy and Commerce  
Subcommittee on Energy

Hearing on  
“Federal Energy Related Tax Policy and Its Effects on Markets, Prices, and Consumers”

March 29, 2017

Chairman Upton, Ranking Member Rush and members of the Subcommittee, thank you for the opportunity to provide our view on how federal tax policy plays an important role for energy development in the U.S. The Lake Erie Energy Development Corporation (LEEDCo) and Icebreaker Windpower Inc., a subsidiary of Fred. Olsen Renewables USA (FORUSA), are pleased to present this written testimony.

Offshore wind on the East and West Coasts and in the Great Lakes holds tremendous technical potential to power our electric grid in a manner that advances many national energy and environmental goals: fuel diversity, energy independence, economic stimulus, job creation, and improved air and water quality. The nation’s first offshore wind project, the Block Island Wind Farm in Rhode Island, is a harbinger of a huge U.S. clean energy industry that will harness an abundant and infinite energy resource in areas where: the winds blow stronger, more consistently, and better timed to match peak electric loads; that are closer to high load regions; and, that are often out of sight.

LEEDCo and FORUSA are developing Icebreaker Wind, a six turbine 20.7 megawatt offshore wind demonstration project in Lake Erie, eight to ten miles off of the shores of Cleveland, Ohio. The mid-west faces rapidly growing energy needs, and many large existing generation resources face retirement or shut-downs. The Great Lakes contain 700 nuclear power plants worth of technical wind potential. Icebreaker will be the first *freshwater* offshore wind project in North America. Our demonstration project will show that we can tap into our nation’s abundant wind energy resource in a manner that is environmentally responsible and boosts local economies.

Just as hydraulic fracturing revolutionized the natural gas industry, our Mono Bucket foundation technology can have a similar impact for the U.S. offshore wind industry. We are currently in the permitting process and working to secure power purchase agreements for the remaining one-third of our output.

The U.S. offshore wind industry is in its infancy, and as a result the power output from offshore wind projects are currently above market prices. Support from private industry and sound government tax policies are needed to allow this promising clean energy industry to develop and grow, to achieve economies of scale, and to realize price reductions. Given the cost structure of the *offshore* wind industry, a federal Investment Tax Credit (ITC) makes the most sense for the offshore wind industry.

Federal tax policies have historically been instrumental in advancing other energy industries that were at the same stage of development the offshore wind industry is today. This would include nuclear power, shale gas, oil, as well as other renewable energy sources. This support has allowed these industries to advance to the point where their costs have declined and government support is no longer necessary. The Section 29 production tax credit for unconventional gas that was in effect from 1980 to 2002, in conjunction with R&D and other forms of government support, were critical factors leading to the shale gas revolution and the dramatic cost declines and shift from oil and coal to gas in the energy industry. Onshore wind is now competitive in the market because of past public policy support (i.e., the federal production tax credit and R&D investment). The same experience will hold true for offshore wind in the near future. In Europe -- where the offshore wind industry has grown to 11,000 megawatts and supports over 75,000 jobs -- the price has plummeted as the industry has grown to scale and been able to establish a competitive market. Current offshore wind projects in Europe are less expensive than coal and nuclear in Europe now.

For all of these reasons, LEEDCo and FORUSA urge your continued support of the long-standing practice of utilizing the federal tax code to invest in nascent energy industries, like the very promising American offshore wind industry. We thank you for your interest and look forward to working with the Committee on this important issue.

For more information, please contact Beth A. Nagusky, Director of Sustainable Development, LEEDCo. Phone: 207.592.1961

**Biomass Thermal Energy Council**  
**Statement for the Record**  
**Before the**  
**House Energy & Commerce Committee's Subcommittee on Energy**  
***Federal Energy Related Tax Policy and Its Effects on Markets, Prices and Consumers***  
**March 29, 2017**

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The Biomass Thermal Energy Council (BTEC) appreciates the opportunity to share our perspective on federal energy tax policy in the context of comprehensive tax reform. BTEC is an association of biomass fuel producers, forest landowners, appliance manufacturers, combined heat and power project developers, supply chain companies and non-profit organizations that view biomass thermal energy as a renewable, responsible, clean and energy-efficient pathway to meeting America's energy needs. BTEC engages in research, education and public advocacy for the biomass thermal energy sector.

Our nation's tax code has long played a key role in shaping and influencing national energy policy. In the renewable energy arena, the code features numerous incentives for most renewable energy technologies in residential, commercial and industrial installations. In fact, analysis provided by the Joint Committee on Taxation lists 80 separate energy-related tax provisions in existing law. Unfortunately, none of these incentives extends to high efficiency biomass thermal energy, despite the fact that biomass thermal energy fulfills all the same public policy objectives as other renewable energy sources. Examples of biomass thermal projects and technologies include heating of homes, businesses, commercial and industrial buildings; district heating of campuses, densely developed commercial and industrial parks; and whole neighborhoods and city downtowns; domestic hot water for large consumers such as hospitals; industrial process heat for companies in food processing, metallurgy, and pharmaceuticals, and combined heat and power projects that produce both heat and electricity for consumers.

BTEC strongly supports tax reform efforts that provide a level playing field for competing energy technologies and pathways. BTEC represents the interests of companies in the biomass thermal energy space, but thermal energy is also derived from solar and geothermal sources. Taken together, thermal energy comprises roughly one third of our nation's energy consumption. Despite this fact, federal energy policy to promote renewable energy has focused entirely on transportation fuels such as ethanol and biodiesel, and electricity from hydro, wind, solar, geothermal and biomass. These fuels and technologies have received support from the federal government in the form of production and investment tax credits, accelerated depreciation, research and development funding, direct project grants, and renewable energy credits. The 2005 Energy Policy Act, the 2007 Energy Independence and Security Act, and the 2009 American Recovery and Reinvestment Act boosted support for these technologies in many areas. BTEC believes that efforts to comprehensively reform the tax code provide the ideal opportunity to rectify this oversight and provide incentives for which thermal energy providers can compete on an equal basis.

Tax incentives will help build a market for high efficiency systems that can reduce American dependence on foreign fossil energy, reduce greenhouse gas emissions, and create jobs and local economic development from a renewable domestic energy resource. Tax policy that supports biomass thermal energy will provide the highest possible return for the country in terms of reductions in fossil fuel imports and jobs created. Per dollar of current federal support, biomass heating displaces ten times more fossil fuel than solar installations or ethanol and is proven to create a greater number of ongoing jobs, primarily in rural economies. Biomass has accounted for 40 percent of the renewable energy jobs in Germany, more than wind, solar or liquid fuels.

Because of the relatively small market penetration of new biomass combustion, these systems are expensive compared to fossil-fueled systems: installed systems can cost twice as much as a similarly sized oil or gas system. Fuel transport logistics have yet to reach critical mass with few customers spread over large geographic areas, thus increasing the unit cost of fuel distribution. Incentives are necessary to make biomass thermal technology more competitive in the market. In time, with increasing market penetration, these incentives can be scaled down or eliminated. As an example, in Europe, there is a thriving biomass heating business employing tens of thousands of people – and the supply of these fuels continues to be cost competitive, even without ongoing government subsidies.

Crafted correctly, incentives can satisfy the twin objectives of supporting innovation while attracting private capital that is critical to driving long term economic growth.

BTEC is a strong supporter of the Biomass Thermal Utilization Act, which will soon be reintroduced in the 115<sup>th</sup> Congress. The bill, known as the BTU Act, would qualify highly efficient thermal energy from biomass for investment tax credits under Sec. 48 and Sec. 25d. The spirit of this proposal is to simply level the playing field so that thermal renewable energy providers are treated equally with those producing liquid fuels and electricity. **Our request to the Committee is to keep this principle—technology and pathway neutrality—as a guide post as you continue to craft energy tax reform legislation.**

### **Conclusion**

Biomass thermal fulfills all the same public policy objectives that are by necessity the basis and justification for renewable energy tax incentives. These include:

- Reduced consumption of foreign fossil energy, thereby increasing America's energy independence
- Increased efficiency of utilization for equivalent energy output, as compared to biomass electric generation and cellulosic biofuels
- Reduced emissions of greenhouse gases due to the carbon neutrality of biomass
- Reduced emissions of certain air pollutants such as sulfur dioxides and mercury, as compared to fossil fuels
- Strengthened local economic development and job creation through domestic production of fuels, system installation and service, and fuel distribution.

The current fiscal environment in which our nation is operating necessitates that tax payer dollars be deployed in a manner that maximizes return on investment. BTEC believes that investment in technologies like biomass thermal that achieve optimal efficiency and job creation potential should be a focus of energy tax reform efforts moving forward. We look forward to working with the Committee as it begins its work on this critical issue.

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<http://www.renewableenergyworld.com/rea/news/article/2008/04/renewable-energy-jobs-soar-in-germany-52089>



**Statement of the**  
**AMERICAN PUBLIC POWER ASSOCIATION**  
**For the**  
**HOUSE COMMITTEE ON ENERGY AND COMMERCE**  
**SUBCOMMITTEE ON ENERGY**  
**Hearing on**  
**“Federal Energy Related Tax Policy and Its Effects on Markets, Prices, and Consumers”**

Submitted March 29, 2017

The American Public Power Association (APPA) appreciates the opportunity to submit this statement for the record in relation to the House Energy and Commerce Committee’s Subcommittee on Energy March 29, 2017, hearing on “Federal Energy Related Tax Policy and Its Effects on Markets, Prices, and Consumers.”

The energy-related provisions in the tax code generally come in the form of tax credits and accelerated cost-recovery and depletion.<sup>1</sup> The Joint Committee on Taxation estimates that these provisions will reduce federal tax liabilities of business and individuals by roughly \$77.5 billion over the next five years. Public power utilities cannot directly benefit from these provisions, but can indirectly benefit, for example through power purchase agreements from entities that do directly benefit. Public power utilities can issue New Clean Renewable Energy Bonds (New CREBs) (with an estimated 5-year tax value of \$600 million). These provisions generally are intended to encourage investments in specific technologies or fuels. In some instances, the influence of tax policy is estimated to be far more substantial than regulatory regimes intended to accomplish similar goals.<sup>2</sup>

The tax code also acts to impede investments by imposing more stringent private use rules for electric energy-related investments financed with municipal bonds. These rules serve to discourage certain types of energy-related investments by public power utilities. These energy-related provisions notwithstanding, the single most important provision of the tax code affecting public power utility investments in generation, transmission and distribution facilities is the tax exemption for municipal bond interest.

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<sup>1</sup> There is also an exception from corporate taxation for certain publicly traded partnerships, the tax expenditure value of which is comparable to other significant energy-tax provisions.

<sup>2</sup> Trieu Mai et alia, National Renewable Energy Laboratory “Impacts of Federal Tax Credit Extensions on Renewable Deployment and Power Sector Emissions,” 13 (2016) (estimating annual average renewable energy additions will be 10,600 MWs greater as a result of tax credit extensions); John Laron, et alia., Rhodium Group, “What Happens to Renewable Energy without the Clean Power Plan?” (Feb. 25, 2016) (<http://rhg.com/notes/renewable-energy-without-the-clean-power-plan>) (estimating that annual utility scale solar and wind capacity additions will total roughly 20,000 MWs in 2019 and 2020 and roughly 5,000 MWs in 2021).

### Background

APPA is the national service organization representing the interests of over 2,000 municipal and other state- and locally-owned, not-for-profit electric utilities throughout the United States (all but Hawaii) referred to collectively as “public power utilities.” These utilities deliver electricity to one of every seven electricity consumers (more than 49 million people). Public power utilities serve some of the nation’s largest cities, but the vast majority of APPA’s members serve communities with populations of 10,000 people or less.

Public power utilities are diverse in structure. Some are vertically integrated, i.e., they own electric power generation, high-voltage transmission, and lower-voltage distributions facilities. Others own distribution resources, but rely on third-party providers to generate and/or transmit the electric power they use. Finally, some public power utilities have been formed to serve as wholesale providers of power to other public power utilities.

For a variety of reasons – including private-use restrictions on tax-exempt municipal bond financing – public power utilities, on average, sell more electric power to ultimate customers than they generate. While public power utilities serve about 14.5 percent of the nation’s homes and business (roughly 22 million electric meters total), these utilities generate about 9.9 percent of the nation’s power (more than 400 million megawatt hours every year).

### Municipal Bonds

Since their establishment in the late 19<sup>th</sup> century, public power utilities have largely relied on municipal bonds to cost effectively raise capital needed to build generation, transmission, and distribution facilities that serve their communities. These projects require substantial upfront commitments of capital, but also tend to have long useful lives. Bonds are a responsible way to finance these costs and repay them over time. This allows the investments to be made and ensures that those customers who are benefiting from the investment are paying for it through their rates. From 2006-2015, nearly 1,400 power-related municipal bonds providing roughly \$110 billion in new money financing were issued.

This is especially important since state and local governmental entities—including public power utilities—have limited means to raise funds for their communities’ capital needs. They cannot issue stock and a local bank loan is rarely an option given the size of the investments required. Moreover, they generally do not use, or even accrue, accumulated cash surpluses in part because doing so would require rate payers to pay the cost of investments from which they may never benefit. Conversely, municipal bonds allow issuers to build long-term projects financed upfront by investors and the debt for which is repaid by residents over the useful life of that investment.

Interest on municipal bonds is exempt from federal taxation,<sup>3</sup> and has been since the creation of the federal income tax in 1913.<sup>4</sup> In contrast to other “tax expenditures,” however, the federal tax exemption of municipal bond interest is part of a trade-off – state and local governments are likewise prohibited from taxing interest on federal debt.<sup>5</sup> While congressional agencies largely ignore this reciprocal arrangement

<sup>3</sup> I.R.C. § 103(a).

<sup>4</sup> Revenue Act of 1913, 38 Stat. 114 (Oct. 3, 1913).

<sup>5</sup> 31 U.S.C. § 3124(a).

when discussing taxation of municipal bonds, the state and local tax exemption has been well-guarded and maintained by Congress.<sup>6</sup>

Likewise, Congress has honed the original exemption from federal tax for municipal bonds, limiting the entities that can issue tax-exempt bonds, the purposes for which the bonds may be issued, and the investment of bond proceeds. Specifically, these laws seek to prevent state and local governments from issuing bonds which finance a facility serving a private activity – rather than financing a facility serving a general public purpose. Generally, if more than 10 percent of a bond finances a private activity and more than 10 percent of the repayment of the bond is tied to revenues from that private activity, then the bond does not qualify as a government purpose bond, but is a “private activity bond,” which is subject to federal income tax.<sup>7</sup>

However, private use rules for power-related bonds are stricter, in effect a “negative tax expenditure” relative to the commonly applied private-use rules. This additional private use limit is just five percent for any power output facility for which the private use will exceed \$15 million. In addition, only up to \$15 million in private use is permitted for all issuances for any one project.<sup>8</sup>

Furthermore, Internal Revenue Service (IRS) implementation of these private-use rules prevent issuers from using tax-exempt bonds to build facilities large enough to meet not just current needs, but future needs. These rules treat near-term excess generation sold outside a public-power utility’s customer base as “private use” even if that excess generation capacity will be needed to meet increased customer demand in the future. Additionally, private use rules severely limit the ability of municipal utilities to acquire existing privately-owned, power-related assets with tax-exempt municipal bonds.<sup>9</sup>

#### Private Activity Bonds

As discussed above, a municipal bond that exceeds private use limits is considered a private activity bond and, generally, is subject to federal tax. However, a private activity bond can be exempt (in whole or in part) from federal tax if it is used to finance certain specific types of qualified facilities or activities. A qualified facility can include an airport, dock, wharf, mass-transit facility, multi-family housing, or solid waste disposal facility.

A qualified facility (or activity) can also be a facility furnishing local electric energy<sup>10</sup> or an environmental enhancement of a hydro-electric facility.<sup>11</sup> The definition of “local electric energy” is very narrow—applying only to facilities furnishing electric energy to either: a) a city and one contiguous county or b) two contiguous counties.<sup>12</sup> Likewise, environmental enhancements to hydroelectric facilities financed by qualified facility bonds are an extremely small portion of the investments made by public power utilities. Given these narrow constraints, power-related qualified facility private activity bonds are relatively rare. For example, in 2015, of 183 power-related municipal bonds totaling \$17.5 billion, just two totaling \$49 million were private activity bonds.<sup>13</sup>

<sup>6</sup> See, e.g., Pub. L. No. 97-258 § 3124, 96 Stat. 945 (Sept. 13, 1982); Pub. L. No. 86-346 § 105, 73 Stat. 622 (Sept. 22, 1959); Public Debt Acts of 1941, Pub. L. No. 77-7 § 3, 55 Stat. 8 (Feb. 19, 1941).

<sup>7</sup> I.R.C. § 141(b)(2).

<sup>8</sup> I.R.C. § 141(b)(4).

<sup>9</sup> I.R.C. § 141(d).

<sup>10</sup> I.R.C. § 142(a)(8).

<sup>11</sup> I.R.C. § 142(a)(12).

<sup>12</sup> I.R.C. § 142(f).

<sup>13</sup> Bond Buyer, “The Bond Buyer/Thomson Reuters 2016 Yearbook” (2016).

### Energy-Related Tax Provisions

By Joint Committee on Taxation (JCT) estimate, the bulk of the tax value of energy tax expenditures come in the form of tax credits for renewable power investments and production (worth \$4.5 billion annually), accelerated cost recovery for oil and gas operations (worth \$3.1 billion annually), and an exemption from corporate taxation for publicly-traded partnerships owning certain energy facilities, generally oil and gas pipelines (worth \$1.2 billion annually).<sup>14</sup>

As not-for-profit entities, public power utilities cannot directly benefit from these provisions. This includes:

- Credits for investing in clean coal technologies;
- Credits for electricity production from renewable resources;
- Credits for investments in certain renewable and other energy producing facilities; and
- Section 1603 grants in lieu of tax credits.

In fact, in so far as public power utilities partner in ownership with entities that do qualify for such credits, the amount of credit available is reduced if tax-exempt municipal bonds are used to finance the public power portion of the project. Likewise, inapplicable to public power utilities are tax code provisions allowing five-year cost recovery for certain energy property, amortization of air and pollution control facilities, and normalization rules preventing accelerated depreciation and the like from reducing the rate base for investor-owned utilities.

To begin to provide comparable incentives to invest in renewable power, in 1992 Congress authorized Renewable Energy Production Incentives (REPI) for public power and cooperative utilities. Congress, however, provided little funding for the program – just \$54 million to pay \$329 million in REPI credits earned by public power and cooperative utilities -- and stopped funding REPI entirely after 2009.

Congress took a different tack in the Energy Policy Act of 2005 (EPAct05)<sup>15</sup> with the creation of Clean Renewable Energy Bonds (CREBS), which have since been replaced by New CREBs. Under current rules, qualified issuers of New CREBs included public power utilities, states and towns, and cooperative electric utilities. Interest paid on a New CREB is taxable, but the bondholder receives a tax credit. The tax credit is calculated by Treasury at the date of bond issuance and set at 70 percent of the level necessary to allow the bond to be issued at the same interest rate as if the bond had been issued as a tax-exempt bond. Alternatively, the issuer may elect to receive the tax credit as a direct payment from the federal government (with the credit calculated the same as if the bond were issued as a tax credit bond). A total of \$2.4 billion in New CREBs may be issued, split evenly between public power utilities, rural electric cooperatives, and state and local governmental entities that are not public power utilities.

As of March 2015, public power utilities have issued a total of roughly \$283 million in New CREBs. By way of comparison, public power utilities typically finance \$9 billion in new projects every year with traditional municipal bonds.<sup>16</sup> And according to JCT tax expenditure estimates, CREB and New CREB tax credits and direct payments are worth roughly \$100 million annually.<sup>17</sup>

<sup>14</sup> Jt. Comm. on Taxation, "Estimates of Federal Tax Expenditures for Fiscal Years 2015-2019," JCX-141R-15 (Dec. 7, 2015).

<sup>15</sup> Energy Policy Act of 2005, Pub. L. No. 109-58 § 1303, 119 Stat. 991 (codified as I.R.C. § 54)(Aug. 8, 2005).

<sup>16</sup> Bond Buyer, "The Bond Buyer/Thomson Reuters 2016 Yearbook" (2011); Bond Buyer, "The Bond Buyer/Thomson Reuters 2011 Yearbook" (2011).

<sup>17</sup> Jt. Comm. on Taxation, *supra* note 13.

As discussed above, CREBs and New CREBs were an attempt to provide direct benefits to not-for-profit utilities making targeted energy investments. However, as a tax credit bonds, CREBs were exceedingly unpopular and New CREBs have been hamstrung by: a burdensome application process; a low cap on bond volume; and a process that provided bond volume allocations of a fraction of the amounts being sought. Additionally, public power utilities that issued New CREBs as direct payment bonds continue to face penalties, with federal budget sequestration cutting otherwise authorized payments since 2013 – sequestration cuts that are now scheduled to continue through 2025.

The IRS announced in February 2015 new procedures for receiving an allocation of New CREB bond volume – i.e., to secure the right to issue a New CREB – including \$527 million in New CREB bond volume available to public power utilities.<sup>18</sup> Data is not publicly available, but many of the same issues hamstringing New CREBs in the past will continue to hamstring them in the future.

APPA has long said that if Congress wants to incentivize energy investments, it should provide comparable incentives to all utility sectors – including not-for-profit entities, which collectively provide power to roughly 27 percent of the nation’s electric power customers.

For example, EPA05 created the IRC § 45J advanced nuclear production tax credit to offset the first-of-a-kind risk of the first 6,000 megawatts of new nuclear generating capacity built after 2005, but placed in service prior to 2021. Since then, construction has begun on four nuclear reactors in Georgia and South Carolina – the first new reactors built in the United States since the 1970s. Additional projects, including the first of a new generation of small modular reactors, are moving through the licensing process at the Nuclear Regulatory Commission, and will be ready for commercial deployment in the first half of the next decade. Nonetheless, the pace of new nuclear plant construction has not been as rapid as Congress had hoped in 2005, meaning credits for 1,600 megawatts of new nuclear power will be stranded by the 2020 placed-in-service deadline. Additionally, those plants which are under construction have required involvement of investor-owned utilities, electric cooperatives, *and* public power utilities. These new nuclear plants now being developed will provide needed baseload electricity; create tens of thousands of new jobs during construction and operation of the plants and through the entire nuclear supply chain; and reduce the electric power industry’s carbon dioxide emissions. However, public power utilities investing in these new plants will not receive the production tax credit. Allowing the credit to be transferred from public-power utilities and extending the placed-in-service date beyond 2020 – as proposed in H.R. 1551 and S. 666 – would directly benefit utilities that are making the investments Congress sought to encourage in EPA05 and encourage further such investments.

#### Defense of Municipal Bonds from Repeal or “Cap”

Modifying the advanced nuclear PTC is a small step Congress could take to accomplish the goals set in EPA05. Likewise, allowing public power issuance of New CREBs is of benefit to the utilities that can receive an allocation. However, for public power utilities, the single most important step Congress could take to encourage energy-related investments would be to stop talking about taxing municipal bonds and start talking about ways to improve the rules surrounding municipal bonds. Every municipal bond issued includes an official statement warning that the tax treatment of municipal bonds could be changed by Congress at any time. The premium that investors demand as a result of this risk is not insignificant. Conversely, this risk premium could be reduced to nearly nothing if policymakers would clearly state their intention not to tax municipal bonds. Savings on new projects would be immediate, reducing electric power rates for customers, or allowing larger investments in needed new infrastructure.

<sup>18</sup> I.R.S. Notice 2015-12 (Feb. 3, 2015).

This threat applies to both an outright repeal of the tax exclusion for municipal bonds and to proposals to “limit” or “cap” the tax value of the exclusion for municipal bond interest. The real-world example of private activity bonds subject to the alternative minimum tax shows that such a “cap” would increase the interest rate demanded by purchasers of municipal bonds.<sup>19</sup> For example, a \$250 million generation project would cost \$40 million more in total debt service were the tax value of bond interest “capped” at 28 percent.<sup>20</sup> The impact on a smaller project would be greater still: a \$25 million grid upgrade would cost an additional \$5 million if the tax value of bond interest was capped.<sup>21</sup>

#### Improvements to Municipal Bonds

Congress could undertake to improve the current-law tax treatment of municipal bonds. APPA supports a recent proposal to repeal the five percent unrelated or disproportionate private business use test (Section 141(b)(3) of the Code) to simplify the private business use test applicable to governmental bonds. This test involves vague factual determinations that can lead to a reduction in the otherwise permitted 10 percent private business use participation to five percent. Treasury has said in the past that the five-percent test creates undue complexity and should be repealed<sup>22</sup> and we agree. We also agree that the “10 percent private business limit generally represents a sufficient and workable threshold for governmental bond status”<sup>23</sup> and would, as a result, recommend that other unnecessary addenda to the 10 percent limit also be reconsidered.

Likewise, Code Section 141(b)(4) provides for a \$15 million private business use/payments limitation on certain output facilities which are part of the same project. The per-project limitation is a punitive rule that singles out governmentally-owned electric output facilities from other bond financed governmental owned assets and systems. Accordingly, we support the repeal of this provision. At a time in which additional electric output and smart-grid transmission and distribution facilities are needed to meet a rising energy needs, the repeal of this per-project limitation would provide needed operational flexibility.

Similarly, Code Section 141(b)(5) provides for a maximum \$15 million private business use/payments limitation on all tax-exempt governmental bonds unless volume cap is allocated to such excess under Section 146 of the Code. This \$15 million limitation, like the \$15 million per-project limitation of Section 141(b)(4), creates undue complexity for municipal issuers and interferes with a policy goal of creating a bright line 10 percent private business use test. We support its repeal.

APPA would also support a revision in the tax treatment of capital contributions by public power utilities to investor-owned utilities (IOUs) to build facilities (e.g., interconnections and associated facilities, transformers, circuits, etc.) to serve the public power utility’s retail demand (“load”). Under current law, these payments are treated as taxable “contributions-in-aid of construction” to the IOU.<sup>24</sup> Because the

<sup>19</sup> Municipal Bonds for America, “Experience with the AMT and Private Activity Bonds Shows ‘Capping’ the Tax Value of Municipal Bond Interest Would Increase State and Local Borrowing Cost,” (Feb. 22, 2017).

<sup>20</sup> BLX Group LLC, “Tax Reform Proposal Analysis: Impact on Tax-Exempt Bond Financing,” prepared for American Public Power Association 6 (Jan. 28, 2013).

<sup>21</sup> *Id.*

<sup>22</sup> U.S. Dep’t of the Treas., “General Explanations of the Administration’s Fiscal Year 2016 Revenue Proposals” at 273 (Feb. 2, 2015).

<sup>23</sup> *Id.*

<sup>24</sup> I.R.C. § 118(b).

IOU traditionally requires the public power utility to “gross up” its contribution, the cost of the investment is effectively increased by as much as 35 percent.

Finally, we support the recent proposal to simplify the arbitrage investment restrictions applicable to tax-exempt bonds under Code Section 148. We fully agree that the investment yield and arbitrage rebate restrictions are duplicative and that these dual restrictions create an unnecessary compliance burden for state and local governments.<sup>25</sup>

Conclusion

The federal income tax includes a variety of provisions intended to encourage energy-related investments. Almost none are of direct benefit to public power utilities, although public power utilities have made limited use of New Clean Renewable Energy Bonds. Conversely, there remain substantial impediments to energy-related investments in rules governing tax-exempt municipal bonds. If Congress is seeking to encourage needed investment in energy infrastructure – of all sorts – it should update the treatment of such investments when financed by municipal bonds and, at the very least, remove the threat of a tax on municipal bonds.

We thank you for your time.

*For more information, please contact:*

John Godfrey  
Senior Government Relation Director  
American Public Power Association  
202-467-2929  
jgodfrey@publicpower.org

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<sup>25</sup> U.S. Dep’t of the Treas., *supra* note 17, at 270.



400 North Capitol Street, N.W.  
Washington, D.C. 20001  
ngvamerica.org

Statement of Matthew Godlewski  
President, NGVAMERICA

United States House of Representatives, Committee on Energy and Commerce, Subcommittee on Energy  
Hearing on "Federal Energy Related Tax Policy and Its Effects on Markets, Prices, and Consumers"

March 29, 2017

**Introduction**

My name is Matthew Godlewski and I am President of NGVAMERICA, the national trade association dedicated to the growing market for vehicles that are powered by compressed natural gas (CNG), liquefied natural gas (LNG), and renewable natural gas (RNG).

NGVAMERICA represents more than 200 companies, including fleet operators; vehicle manufacturers; natural gas vehicle component manufacturers; natural gas distribution, transmission and production companies; non-profit advocacy organizations; and state and local government agencies who are dedicated to creating a level playing field among transportation fuels and committed to the natural gas vehicle marketplace.

Our members range from publicly traded to multi-generational family-held companies, and from national fleet operations to small and midsize regional businesses. We represent a broad cross-section of America's job providers.

On behalf of NGVAMERICA's members – and the thousands of men and women they employ – I want to thank the committee for its work in this very important area and ask that my comments be submitted for the record.

**Comments**

Since 1992, NGVAMERICA has been working with lawmakers to implement financial incentives, programs and research in support of the domestic natural gas vehicle (NGV) industry. Fuel and infrastructure tax credits have played a significant role in the acceleration and adoption of natural gas as a transportation fuel and we look forward to continuing to work with Congress on behalf this important industry.

The significant environmental benefits associated with growth in the use of NGVs have been well documented. But increased natural gas usage has an important economic benefit as well, making it a particularly good investment.

For example, greater use of domestic natural gas stimulates job growth and provides state and local revenues, as well as federal royalties. Using natural gas as a transportation fuel also helps fleets and businesses lower their operating costs, thus increasing economic prosperity.

Currently, there are approximately 165,000 natural gas vehicles on the road in the United States, compared to about 23 million worldwide. But the potential for significant growth – and the economic benefits that will result – is in place:

- In the U.S., virtually every heavy-duty truck manufacturer and most transit bus manufacturers offer a selection of natural gas vehicles.
- A wide variety of light and medium vehicles also are available directly from manufacturers or offered through arrangement with automotive suppliers to make natural gas vehicles available to their customers. For example, Ford’s entire commercial truck line-up is available in natural gas.
- Fuel providers have been actively adding to the number of fueling outlets that offer vehicular natural gas, as well. There are more than 1,700 natural gas fueling stations in the U.S.
- Innovation is at the forefront of our industry. The Cummins Engine Plant in Rocky Mount, North Carolina is where the revolutionary Cummins Westport “Near Zero” natural gas engine is built. This engine reduces harmful nitrogen oxide emissions by 90 percent from the current Environmental Protection Agency (EPA) standard. This product has been specifically designed to deliver emissions that are comparable to zero emission vehicles and to address the need for heavy-duty nitrogen oxide emission reductions.

The availability of extremely clean engines, combined with significant advancements in drilling technology and the vast natural gas resources that are now economically recoverable, provides an unprecedented opportunity for natural gas and the country. Our nation is in a position to displace a significant share of its petroleum imports with domestically-sourced, cleaner-burning and economical natural gas in the transportation sector. But to accomplish this, we will need the government’s continued cooperation and leadership.

Businesses across America have benefitted from Congressional backing of NGVs as an affordable, viable option. However, to be more effective, policies that provide incentives for clean technologies need to deliver greater certainty for businesses and industries.

Specifically, we encourage Congress to extend the \$.50-cent tax credit for natural gas used in transportation – which expired on December 31, 2016 – for five years. The credit helps offset the cost of owning and operating a natural gas vehicle, thus encouraging more fleets to adopt the technology. A five-year extension of this fuel credit will provide small businesses, municipalities and others with the certainty they need to make long-term investments that will create more jobs and put the cleanest trucks and buses on the road.

In addition, NGVAmerica is working to modernize legacy tax policies that serve as barriers to increased use of natural gas as a vehicle fuel by creating fairness in tax treatment of natural gas fuels compared with traditional gasoline and diesel. Amending the federal excise tax (FET) on the sale of heavy-duty trucks, trailers and tractors is a prime example. The FET is an onerous burden on business of all sizes, but in the case of NGVs, is particularly burdensome as it is levied on the total cost of the vehicle, including the incremental cost above its gas or diesel equivalent. The added tax charged for cleaner natural gas trucks increases acquisition costs and discourages businesses from purchasing what is truly the cleanest available technology.

Finally, building out a national fueling infrastructure to support a new fuel like natural gas is no easy task. It is a uniquely challenging undertaking that requires enormous capital and confidence that the demand for the new fuel will materialize. Providing tax incentives will help secure the needed investments in natural gas vehicles and increase demand for vehicles. This, in turn, will encourage more businesses to develop fueling stations that provide natural gas, and it will reward manufacturers who are investing in producing natural gas vehicles and natural gas fueling equipment.

Looking forward, the potential for natural gas is exponential, but it cannot be developed in a vacuum. Supporting tax incentives for NGVs is an investment that will pay dividends today, supporting needed jobs in communities all over the U.S., and tomorrow, as NGVs continue to provide much-needed environmental benefits.

As tax reforms are debated, NGVAmerica looks forward to continuing to work with Congress, the administration and other key stakeholders to share the NGV success story and further understanding about how a robust domestic natural gas market will benefit all Americans.

