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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, D.C.

The subcommittee met, pursuant to call, at 10:15 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,

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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, Digital Coordinator/Press Secretary; 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; Chris 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, External Affairs; Everett Winnick, Director of Information Technology; Andy Zach, Senior Professional 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

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Ratner, Minority Policy Analyst; and Tuley Wright, Minority Energy and Environment Policy Advisor.

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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.

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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

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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. 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

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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, D.C. 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.

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

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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.

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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

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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 de-centralized 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

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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.

The Chairman. Thank you very much. Go Ducks, yes. Sorry about Michigan.

Mr. Upton. Time has expired.

[Laughter.]

The Chairman. That is what happened, kind of ran out.

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

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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 non-tax 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

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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 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

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

Mr. Pallone. Thank you, Mr. Chairman. Thanks for holding

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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

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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

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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 non-taxed 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

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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.

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 Dinan --

Ms. 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

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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 --

Ms. Dinan. Thank you.

Mr. Upton. -- thank you. You are recognized for 5 minutes.

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STATEMENTS OF TERRY DINAN, SENIOR ADVISOR, CONGRESSIONAL BUDGET OFFICE; ROBERT MURPHY, SENIOR ECONOMIST, INSTITUTE FOR ENERGY RESEARCH; DEVIN HARTMAN, ELECTRICITY POLICY MANAGER, R STREET INSTITUTE; STEVE CLEMMER, DIRECTOR OF ENERGY RESEARCH AND ANALYSIS, UNION OF CONCERNED SCIENTISTS; JOSEPH ALDY, ASSOCIATE PROFESSOR OF PUBLIC POLICY, HARVARD KENNEDY SCHOOL; AND, BEN ZYCHER, RESIDENT SCHOLAR AND JOHN G. SEARLE CHAIR, AMERICAN ENTERPRISE INSTITUTE

STATEMENT OF TERRY DINAN

Ms. 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

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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. Okay.

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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

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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.

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[The prepared statement of Ms. Dinan follows:]

*****INSERT 1*****

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Mr. Upton. Thank you.

Dr. Murphy.

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STATEMENT OF ROBERT MURPHY

Mr. 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

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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

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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 give 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

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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

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standard of living. Thank you, and I look forward to answering your questions.

[The prepared statement of Mr. Murphy follows:]

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Mr. Upton. Thank you.

Mr. Hartman? Got to keep talking.

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STATEMENT OF DEVIN 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

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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

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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 relationships. 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

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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:]

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Mr. Upton. Thank you.

Mr. Clemmer?

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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,

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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,

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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 percent 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 is 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

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benefits of increasing renewable energy are two to three 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:]

*****COMMITTEE INSERT 4*****

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Mr. Upton. Thank you.

Mr. Aldy?

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STATEMENT OF JOSEPH 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

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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

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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

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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

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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:]

*****INSERT 5*****

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Mr. Upton. Thank you.

Dr. Zycher?

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STATEMENT OF BEN ZYCHER

Mr. 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

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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

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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

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international level using the EPA's own climate model.

It would be hugely productive for the U.S. economy were policymakers 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 Mr. Zycher follows:]

*****INSERT 6*****

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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

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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.

Mr. 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

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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. Okay, 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

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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 have used tax policy as a way to implement energy policy and there is 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.

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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. Okay, 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. Okay, thank you.

Mr. Aldy, would you like to comment on that benefit of carbon pricing?

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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 non-benefits 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 ten 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

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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?

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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

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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,

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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

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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 of 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

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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,

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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 --

Mr. 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

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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

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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.

Ms. 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?

Ms. 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,

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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.

Ms. 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

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the question of second, third, and fourth best policy mechanisms.

Mr. Pallone. Okay. 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?

Mr. 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. Okay. 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?

Mr. 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

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costs?

Mr. 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

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in the world that has a better, more diversified energy production market than the United States?

Mr. 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?

Mr. 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

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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 subcomponents 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

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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 okay 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?

Mr. 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

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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 --

Mr. Zycher. Right.

Mr. Barton. -- 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

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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.

Ms. 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.

Ms. Dinan. So where would employment have been greater in the absence. And so CBO has not taken a careful, has not yet

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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

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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

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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

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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. Okay. 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?

Ms. 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

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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?

Ms. 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.

Ms. Dinan. Okay. 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 emissions, 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. Latta. Thank you.

Dr. Zycher, if I could ask you how has the tax code affected consumer choice?

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Mr. 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. Latta. 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.

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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

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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?

Ms. 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?

Ms. 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

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would trigger a broader analysis?

Ms. 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. Okay. 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 has 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

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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 has 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?

Mr. 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

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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 form 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.

Mr. 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 website 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

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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. Okay. 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?

Mr. 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

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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 ignores 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 Interagency Program in Boise, Idaho, there is 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

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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

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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 Dr. Zycher keeps bringing up this issue of renewables being more polluting than fossil fuels which is ludicrous.

Mr. 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.

Mr. Zycher. Yes.

Mr. Clemmer. And the study he is referring to has been thoroughly debunked. It was a long time ago and there has actually been dozens of studies by regional transmission

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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

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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.

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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. Okay, thank you. I believe my time has expired

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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.

Mr. Zycher. Yes. Is your question if we had a hundred percent grid powered by wind and solar power?

Mr. McKinley. Right.

Mr. 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 --

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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?

Mr. 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. Okay. Well, I am not opposed to wind and solar. I think it is unique. I think it 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

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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?

Mr. 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. Okay, and just in the closing let me just make sure I understand, Dr. Murphy, your statement you make in your

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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?

Mr. 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. Okay. 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?

Mr. 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

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that that would provide, if we were to become more reliant on wind and solar that we would have an unreliable grid?

Mr. 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, political 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

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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,

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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. Loeb sack. 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

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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. Loeb sack. 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

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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

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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. Okay, 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

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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?

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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. Okay. 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.

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[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

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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

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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?

Ms. 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

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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?

Ms. 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.

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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 --

Mr. 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.

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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

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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.

Mr. Zycher. Well, I mean there are two different questions

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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 ten 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 some interest because just something I read about a number

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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.

Mr. 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. 70 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

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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

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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.

Mr. 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 --

Mr. Zycher. -- equals the marginal benefit of doing so. If you don't believe that fine, then the EPA is violating the terms

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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?

Mr. 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.

Mr. 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

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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?

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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

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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

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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. Okay. 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.

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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. Okay, 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?

Mr. Zycher. Well, certainly in directionally if you

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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. Okay. 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?

Mr. 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

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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?

Mr. Murphy. Right, right.

Mr. Johnson. Okay, 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

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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 D.C. 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

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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

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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

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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 expose 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?

Mr. 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

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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. Okay. 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?

Mr. Murphy. Well, sure. So yes, just to follow on, I think I am coming from a slightly different angle. My position on this

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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. Okay. 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

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finally, will this rising cost hurt the global competitiveness of energy-intensive industries like American steel and manufacturing?

Mr. 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. Okay, 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,

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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 follows:]

*****COMMITTEE INSERT 7*****

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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.]