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Thank you Chairwoman Stabenow, and members of the Committee for inviting me to join you today to talk about tax policy and its relationship to the future of energy policy in the United States. I would like to submit my full testimony for the record and will summarize it in the time that I have this morning.

At the outset, it is worth noting the remarkable energy transformation that has occurred in less than a decade in this country. Six years ago, our country was more than 60 percent dependent on imported oil. Efficiency in the transportation sector had been stuck for several decades.

Today, our energy picture is far different from just a few years ago. Oil imports as a percentage of consumption have been reduced to 40 percent. Our electric sector energy sources have been diversified, with approximately one-third of our electricity coming from coal, one-third from natural gas; and one third from nuclear, hydro and renewable energy sources. End-use efficiency is also having a major impact in the transportation, buildings and commercial sectors. As a result, consumption in transportation and electricity has stabilized and is not expected to grow substantially in coming decades.

All of these trends are producing positive impacts for the American people. Economically, we've seen our balance of trade improve because we are importing less oil. Stable and

relatively low energy prices are good for consumers and have spurred increased manufacturing activity. Our reduced reliance on imported petroleum is enhancing our national security. And we are making progress toward the President's goals in terms of doing our part to reduce global carbon emissions.

Through innovation we are producing more and using less energy. As a result, our economy is stronger, our country is more secure and the environment is cleaner. The lesson is clear – diversification and advanced energy technologies must be cornerstones of U.S. energy policy and the tax policies that support it.

In the remainder of my testimony, I will provide the Committee with a window on how advanced, clean energy sources are part of these developments and also represent a tremendous opportunity for our economic, environmental and national security interests as a nation.

Simply put, clean energy technologies have moved from the margins to the mainstream of global energy markets as a result of increased global demand, worldwide economic competition and the resulting dramatic decline in the price of solar, wind and other emerging technologies.

The emerging size and scope of the global clean energy sector has been chronicled by The Pew Charitable Trusts over the past four years in a series of reports entitled "Who's Winning the Clean Energy Race?" Our most recent report was issued in April of this year and the 2012 data show that clean energy is a significant, growing sector of the global economy. While investment levels declined 11 percent to $269 billion in 2012, deployment of clean generating capacity increased by more than 10 percent to a record 88 gigawatts in 2012.

Our research shows that:

- Clean energy investment is shifting from the West to the East. Last year, Asia/Oceania became the leading regional destination for clean energy investment for the first time ever, attracting $101 billion in private investment – 42 percent of the global total.
- Investment in technologies is also shifting. For the second year in a row, the solar sector attracted more financing than any other clean energy technology: $126 billion in 2012. China, Europe, and the United States were top markets for investment.
- Prices for solar panels and wind turbines are declining as competition and deployment increases. In 2012, solar generating capacity grew by 4 percent to 31 gigawatts and wind added 48.6 gigawatts of capacity – record amounts for both categories.
- Markets in developing countries are growing most rapidly. In 2012, 20 percent of private investment went to non-G20 nations. Previously, the G-20 nations accounted for 95 percent of investment.

And the evidence suggests that the positive momentum and market penetration of clean, renewable energy will continue. Recently, the Bloomberg New Energy Finance research team estimated that clean energy investment is most likely to grow by 230 percent to a projected $630 billion annually in 2030. This same study estimates that 70 percent of new power generating capacity added worldwide over the next 25 years will be renewable.

The rationale for the clean energy revolution is no different than the rationale for the ongoing natural gas revolution. National governments, businesses and consumers are turning to clean energy to meet three basic interests: energy security, environmental security and economic opportunity.

Energy Security

Energy price volatility in recent decades has caused individuals, businesses and countries to seek out opportunities to enhance energy security and reduce vulnerability to price shocks or supply disruptions. In fact, our military has taken a position of institutional leadership in deploying clean energy as part of its effort to ensure the security of supply so that no mission and no warfighter is compromised by energy supply disruptions.

We've made great strides in enhancing our energy security in recent years by increasing efficiency, bolstering domestic supply of conventional fuels and deploying advanced energy technologies and fuels that help to diversify the energy mix. The transformation of the electric sector illustrates the change underway. FERC energy infrastructure data shows that gas and renewable energy sources have accounted for more than 80 percent of U.S. electric power capacity additions in three of the last four years. In 2012, renewables (mostly wind) accounted for 47 percent of all power capacity additions, with gas accounting for another 33 percent.

Environmental Security

Globally, concern about emissions associated with the combustion of fossil fuels that are harmful to human health and the environment is also spurring the deployment of clean energy technologies. Both the public and private sectors are embracing clean energy as a means of reducing local and global air pollution.

The U.S. Environmental Protection Agency estimates that electricity generation creates the lion's share of industrial air emissions in the United States, including "67 percent of national sulfur dioxide emissions, 23 percent of nitrogen oxide emissions, and 40 percent of man-made carbon dioxide emissions."[1]

The predominant fossil fuels used to generate electricity produce much more global warming related pollution than clean energy sources. Accounting for all aspects of production and use, coal results in about 20 times and natural gas 10 times the global warming related pollution as clean energy counterparts.[2]

Economic Opportunity

Recognizing public and private interests in energy and environmental security, investors see clean energy as a major economic opportunity for the future. To meet increased worldwide demand, the U.S. Energy Information Agency estimates that global energy consumption will increase by 47 percent between 2010 and 2035.[3] Eighty-five percent of that growth will occur in emerging and developing economies. The International Energy Agency estimates that clean energy will provide more than half of that new capacity,[4] and could attract up to $5.9 trillion

worth of investment.[5] In the last 8 years, renewable energy has garnered more than $1.3 trillion worth of investment.

There is no doubt but that these investments are going to create jobs and economic opportunities for the countries and companies that are at the forefront of the clean energy industry. Already, an estimated 5.7 million jobs around the world were connected to the clean energy sector as of the end of 2012.[6] In the United States, an estimated 152,000 Americans are employed in biomass, 100,000 employed in solar, and 75,000 are employed in the wind sector.[7]

The expansion of clean energy is also helping provide new manufacturing opportunities in the United States and other nations. According to the Solar Energy Industries Association, one-fourth (25,000) of all jobs in the U.S. solar sector are in manufacturing.[8] In recent years, American wind power has created almost 500 domestic manufacturing facilities and today, the manufacturing sector sources 30,000 domestic wind jobs.[9] The U.S. wind supply chain has grown in recent years, with 70 percent of the component parts of wind installations in the United States being sourced domestically.[10] Recent research has shown that investments in clean energy have yielded more than three times the number of jobs as comparable investments in conventional fossil fuels.[11]

WHERE THE UNITED STATES STANDS

With the global clean energy sector growing in size and reach, the United States finds itself at a competitive crossroads. Once a world leader in innovation, manufacturing, deployment and export of clean energy technologies, the United States now faces considerable competitive

challenges, as the center of gravity in worldwide clean energy leadership shifts from the industrialized Western powers to the emerging economies of Asia.

China appears to have established a lead in the clean energy race. Attracting $65.1 billion in private investment in 2012, China accounted for 30 percent of total investment among G-20 nations and attracted leading levels of investment in wind, solar and other renewables. All told, 23 gigawatts of new clean generating capacity were installed in China.

Whereas investment in China's clean energy sector has been increasing steadily, investment in the United States has been a roller coaster. Uncertainty surrounding the future of the production tax credit spurred unprecedented wind energy installations in the United States in 2012. But the rush to complete wind projects was insufficient to stem a 37 percent drop in U.S. clean energy investment. Overall, the United States saw some $35.6 billion invested, second-best among G-20 nations. Of that, $16.5 billion was invested in the solar sector and $13.9 billion went to wind energy technologies, enabling a U.S.-record 13.6 gigawatts of installed wind energy and 3.2 gigawatts of solar energy. The solar sector was something of a bright spot for the United States, with financial innovations such as private third-party financing leading to an investment increase of more than 40 percent for residential photovoltaic installations. In the United States, third-party financing mechanisms accounted for more than half of the residential and commercial market for rooftop solar installations.

The United States continues to lead the G-20 in the energy-efficient/low-carbon technology and the biofuels-related categories, which attracted $2.5 billion and $1.5 billion, respectively. In addition, venture capital and private-equity investment in the United States continued to dominate that class of financing, accounting for $4.3 billion of the $5.6 billion invested, or 78

percent of the total. Similarly, public and private research and development investment was highest in the United States, which accounted for 29 percent of the worldwide total.

With the United States leading the world in various measures of energy innovation but lagging far behind in such categories as deployment and manufacturing, it's evident that the United States is underperforming—inventing but failing to realize the economic, security, or environmental benefits of clean energy innovations through production and utilization. Installation of 3.2 gigawatts of solar was a record, but it is still less than half the amount that has been installed annually in leading European markets in recent years.

With regards to solar manufacturing, the United States has seen its early lead in this rapidly emerging sector steadily erode.[12] Over the last decade, manufacturing leadership has shifted from the United States to Japan, Europe, and more recently to Asia.[13] In 2012, nine of the top 15 solar PV module manufacturers were located in China. Although the U.S. solar manufacturing sector comprises about 100 production facilities making primary PV components (polysilicon, wafers, cells, modules, and inverters),[14] the United States is home to only two of the world's top 15 solar photovoltaic manufacturers, including First Solar, the second leading manufacturer in the world.

In the wind sector, one American company – GE Wind Power – is the leading manufacturer in the world, but the rest of the top 10 is comprised of Asian and European companies. Still, the United States has developed a significant supply chain in the wind sector. At the end of 2011, 470 wind turbine-manufacturing facilities were located in the United States.[15] This represents a more than 10-fold increase from the 30-40 wind-related manufacturing factories in 2004. In the intervening years, the number of tower plants increased from 6 to 22, blade facilities increased from 4 to 11 and the number of nacelle (housing for mechanical gears) assembly shops increased

from 3 to 12. As a result, it is estimated that 70 percent of the components in U.S. wind turbines are manufactured domestically, up considerably from half a decade ago.[16]

FEEDBACK FROM ROUNDTABLE DISCUSSIONS WITH INDUSTRY

To gain a better sense of the clean energy industry in the United States, last year The Pew Charitable Trusts organized a year-long, nationwide series of meetings with leading public and private sector experts, including business leaders in the areas of finance, manufacturing, innovation and deployment, to gather their feedback as to the strengths, weaknesses and opportunities for progress in the U.S. clean energy sector.

Roundtables were held as follows:

- **New York City, New York, March 19, 2012** – Finance Roundtable convened in conjunction with Bloomberg New Energy Finance
- **Columbus, Ohio, April 25, 2012** – Manufacturing Roundtable convened in conjunction with the Central Ohio Hub for Advanced Energy Manufacturing, EWI and the Ohio Manufacturers' Association
- **Golden, Colorado, May 9, 2012** – Innovation Roundtable convened in conjunction with the National Renewable Energy Laboratory
- **Atlanta, Georgia, June 14, 2012** – Deployment Roundtable convened in conjunction with the Georgia Solar Energy Association.
- **Jackson, Mississippi, August 7, 2012** – Deployment Roundtable convened in conjunction with the Mississippi Technology Alliance.

At this point in my testimony, I'd like to share with you some of the major themes we identified from these listening sessions with the industry.

Policy Uncertainty

Lack of certainty about the direction of U.S. energy policy was identified as the overriding impediment to clean energy investment and progress. The boom and bust nature of U.S. clean energy policies makes it extremely difficult for emerging industries to develop the supply chains and business models needed to establish a foothold in the competitive energy marketplace. Uncertainty also shakes the confidence of potential investors and keeps capital on the sidelines.

The looming expiration of the Production Tax Credit (PTC) was cited repeatedly as the most obvious and serious illustration of the difficulties associated with policy uncertainty. Prior episodes of uncertainty surrounding the renewal of the PTC resulted in a 70-95 percent drop in wind energy orders in 2000, 2002 and 2004.[17]

But the PTC is not the only uncertainty that exists – research and development funding is another example. Overall, participants lamented that currently there is neither a clear sense of purpose nor direction to U.S. energy policy. In the past, it was observed, the energy sector has been successful in meeting significant public policy goals set for the industry, such as making affordable electricity universally available in the United States. Similar goals are needed now to help focus the interests and efforts of scientists, investors, businesses and the citizenry. Policymakers are encouraged to set long-term goals that foster an economy-wide transformation toward advanced energy technologies that are cheaper, cleaner, and domestically available, thereby advancing the long-term prosperity of the United States.

International Competition

Worldwide interest in low-carbon and domestically-sourced energy supplies is creating momentum in clean energy deployment, as outlined above. Because clean energy is seen as an important economic opportunity, there has been a rush of investment in clean energy manufacturing in recent years. The speed and scale of investment in clean energy manufacturing capacity has spurred dramatic reductions in the market price for solar and wind products. The price of solar modules dropped 50 percent in 2011 alone and wind prices were down 10 percent. Recent estimates suggest that for every doubling of production capacity, the cost of manufacturing solar drops by 17 percent.[18]

Declining prices have been beneficial for consumers but stressful for producers, which now face acute global competition. In response to falling prices and growing deployment, manufacturers are making more product but at less profit. In the United States, Spain, Germany and China, several manufacturers have ceased or slowed production or gone out of business altogether, and more may soon follow. These are the realities of today's intensely competitive marketplace.

Several roundtable participants noted that the difficulties currently facing the clean energy sector are similar to those encountered in the past by other emerging technologies. The early stages of the computer and automobile industries were characterized by scores of early market entrants and subsequent consolidation. For example, it was noted that there were more than 100 car manufacturers in the early days of the industry. Experts involved in our discussions indicated that partnerships and consolidation between large and small businesses are likely to occur in the coming months and years.

Over the long-term, it is expected that the intense competitive pressures will strengthen the industry for the future. To survive and prosper, companies will have to pursue cost-saving

measures aggressively. Some of these savings will occur through improved materials and technological innovation. But industry representatives participating in our roundtables indicated that they are vigorously exploring ways to reduce "balance of system" costs across the value chain – from improved manufacturing processes to reduced financial, legal, transportation, permitting and installation costs.

It was also noted that, over the long-term, competitive pressures will place a premium on some of the strengths of American business -- including its commitment to producing high-quality products and ability to innovate across the supply chain. For example, General Electric has staked a leadership position in the production of larger and taller wind turbines that are more productive and cost-effective for customers.

Tight Credit

Recent global economic challenges and associated tight credit markets have made it difficult to raise the capital needed to grow businesses and scale up technologies in many sectors of the economy; clean energy included. Beyond the well-documented credit crunch, Pew's roundtables in 2012 revealed a number of special and distinct challenges facing clean energy businesses in the United States.

As noted previously, financing in the clean energy sector has been inhibited by perceived federal policy uncertainty. In addition, clean energy and other emerging technologies must overcome stubborn perceptions of risk, which discourage investment and increase the cost of capital.

Clean energy also faces challenges associated with the scale of its financial requirements. The energy sector is unlike the information technology or other high-tech industries—which can be

brought to scale at relatively low cost. In the energy world, considerable amounts of initial capital are needed to finance the scaling of newer technologies.

While the United States leads the world in private venture capital investments associated with clean energy, these investments typically occur in the earlier, proof-of-concept stage of technological development. Venture capital funding may not be a good fit for the commercialization of promising clean energy technologies and projects because of the large upfront capital requirements involved.

That is why predictable, long-term incentives are needed to usher this emerging industry as it approaches broad market acceptance. Declining prices are moving clean energy technologies closer to cost-competitiveness without subsidies. Already, clean energy is cost-competitive in certain domestic markets, many developing country markets (e.g. residential markets in areas with high electricity costs) and in areas with no power infrastructure. In our roundtables, we learned that the industry envisions and welcomes a subsidy-free and competitive marketplace among energy options in the power generation sector.

In fact, there is growing interest in private sector development of innovative new financing mechanisms for clean energy projects. The rapid emergence of third-party financing structures for residential solar energy projects was cited as a promising recent trend.

More broadly, experts welcome a move in the private sector to develop financial instruments suited to raising capital through broader pools of investors. Asset-backed securities, bonds and investment trusts are among the tools private sector interests are looking at to increase liquidity. In this regard, participants welcomed the entry into clean energy finance of large financial

institutions such as Goldman Sachs, Bank of America, Wells-Fargo, Citigroup and Warren Buffet's Mid-American Energy Holdings.

The Energy Playing Field is Not Level

Industry roundtable participants expressed a keen interest in "leveling the playing field" between conventional and emerging power technologies. Clean energy businesses welcome the opportunity to compete head-to-head with incumbent technologies but do not believe that the current marketplace allows for this kind of fair competition.

First and foremost, industry participants noted the sustained and substantial subsidies that conventional energy technologies have received over a period of decades. For example, some conventional energy subsidies have been in place for close to 100 years.[19] Similarly, it was mentioned that there are only four permanent tax credits in the energy sector, three of which are enjoyed by the oil and gas industry and one by the nuclear industry.[20] In contrast, clean energy tax credits are short-term and episodic.

Second, it was observed that the health and environmental costs associated with conventional energy sources are not reflected in the marketplace. If these costs, ultimately borne by society, were internalized in the price of various energy options, clean energy sources would be cost-competitive immediately. Health costs, the impacts of global climate change, and the costs of securing foreign sources of oil were mentioned among the external costs not currently reflected in energy pricing. Water was also discussed as a resource that should be considered in evaluating the relative merits of energy technologies. Conventional electric generating sources require large volumes of water to operate.

Finally, it was noted that there are a host of ways in which existing laws and regulations create barriers to clean energy development. In particular, participants mentioned rules associated with those who can generate electricity and barriers to connecting to the grid. Georgia, for example, is one of five states that prohibit anyone other than a publicly regulated utility from generating electricity.

U.S. CLEAN ENERGY OPPORTUNITIES

Leadership in Clean Energy Innovation

It is widely recognized that the United States has been at the forefront of research and development of clean energy technologies and remains a world leader in this area. That said, U.S. leadership in the innovation arena is being challenged, especially by emerging economies in Asia. Experts from industry and the research community agree that a number of steps need to be taken to ensure that the United States maintains its leadership in clean energy innovation.

There is broad consensus that U.S. clean energy research and development funding should be significantly increased. Due to international competitive pressures, experts believe that the United States must make robust investments to maintain a pipeline of clean energy innovations that will allow the country to stay ahead of international competitors in terms of developing products that compete on cost and quality in the global marketplace. To succeed, U.S. research and development efforts need to be funded on a consistent and long-term basis. Clean energy research and development has suffered as a result of frequent fluctuations in funding.

Participants welcomed recent initiatives in clean energy research, including the establishment through the Department of Energy of Energy Frontier Research Centers, Energy Innovation

Hubs and the Advanced Research Products Agency-Energy (ARPA-E)*.The Department of Energy's Sunshot Initiative, which aims to make solar energy cost-competitive without subsidies by 2020 was cited as one example of an appropriate, performance-oriented research and development initiative.

Roundtable participants suggested that government research and development efforts need to be aligned more effectively with U.S. commercial interests and objectives. The National Laboratories and other research entities need to be accessible to businesses and university-funded research should also take account of the needs and interests of American industry. Research and development efforts should address innovation needs across the technology development spectrum, from basic research through manufacturing and operations.

Manufacturing

Most roundtable participants felt that there are a variety of opportunities for the United States in clean energy manufacturing, particularly in keeping a focus on the production of next generation technologies that harness domestic advantages, such as highly skilled labor. Underscoring this sentiment, Pew recently released results of a study on trade between the United States and China in key parts of the clean energy sector.

Our research showed that the United States held a $1.63 billion trade advantage with China in 2011 across three sectors: solar, wind and energy-smart technologies. We found that U.S. companies excel in production and sale of complex, high-margin, and performance-critical goods. This includes capital equipment for manufacturing solar panels and LEDs, specialty chemicals and materials needed for production of solar and wind products, as well as controls for

energy systems. In short, our trade advantage with China is based in large part on national leadership in innovation.

Throughout the roundtable process, it was noted that in today's highly competitive environment, cost-effectiveness across the value-chain is imperative and therefore, domestic manufacturers are likely to have an advantage in U.S. markets. In turn, servicing of domestic markets should help U.S. manufacturers become more competitive in international markets.

Indeed, it is widely acknowledged that domestic manufacturing must be viewed as part of the innovation process. Commercialization and manufacturing of next generation technologies help identify opportunities for improved materials, new production processes and other advances which are not only needed to reduce technology prices but also can be export opportunities. In this regard, experts note that the U.S. research and development community must work more closely with manufacturers.

Domestic Deployment

Roundtable participants consistently noted the importance of stimulating domestic demand as a means of encouraging the development and success of the U.S. clean energy sector. A domestic demand signal will encourage private investors to provide the capital needed to spur U.S. innovation and manufacturing in the sector. It will also help to encourage domestic manufacturing, as manufacturers prefer to be close to customers. In the wind industry, transportation costs and requirements necessitate close proximity between manufacturing facilities and wind farms. Several participants noted that U.S. manufacturers are disadvantaged by the fact that demand has been strongest in Europe and now in Asia. Ambitious national goals

and targets for deployment of specific clean energy technologies have stimulated local industry in these regions.

Enhanced deployment of clean energy technologies in the United States is also expected to drive innovations by manufacturers and project developers as they seek to reduce costs and gain a competitive advantage. As noted previously, the experience curve associated with solar and wind suggests that enhanced production drives down the cost of a given technology over time.

More efficient use of energy in manufacturing, particularly natural gas, can also drive down costs and spur new investment that strengthens U.S. manufacturing competitiveness in clean energy and other sectors of the economy. Steel companies including ArcelorMittal, automakers like BMW, and even Las Vegas casinos have made significant investments in combined heat and power and waste heat to power technologies because they lower energy costs while providing greater reliability. The Oak Ridge National Laboratory has estimated that doubling U.S. combined heat and power deployment can attract $234 billion in new private investment and create one million new jobs across the country while lowering total energy use by 3 percent.[21]

By encouraging price declines and stimulating innovation, a domestic demand signal would allow the public sector to diminish its role in clean energy as the private sector position strengthens.

STRATEGIES FOR STRENGTHENING OUR CLEAN ENERGY FUTURE THROUGH GREATER INNOVATION, MANUFACTURE, DEPLOYMENT AND EXPORT

To be internationally competitive in the emerging clean energy sector, the United States' public and private sectors were advised by participants to work closely together to innovate, manufacture, deploy and trade the advanced energy technologies that consumers around the world want and need. Participants in the Pew roundtables were optimistic that an effective public-private partnership can be created to ensure that the United States is an effective and successful competitor in the global clean energy marketplace.

A plethora of public policy ideas exist for strengthening America's competitive success in the clean energy sector. However the consensus of stakeholders participating in our nationwide series of roundtables is that relatively narrow, straightforward and mutually-reinforcing steps should be pursued. There is broad consensus among these leaders that the U.S. government's role in the sector should be light, limited and time-bound—federal policy has helped bring clean energy to the cusp of market acceptance and now, with commercial success in sight, would be an unpropitious time to change course. Roundtable participants suggested policymakers consider adoption of the following measures to help enhance the competitive standing of the United States in clean energy. Three of the six are directly related to tax policy.

Policy Recommendation #1: Set a Long-Term Goal for Clean Energy Deployment

Establishment of a clear, consistent and long-term goal for the development of clean energy (such as a Clean Energy Standard) was identified by roundtable participants as the single most important step that should be taken by policymakers to enhance U.S. industry in this sector. The

initiation of national goals corresponds to increased clean energy investment, manufacturing and jobs in the United States. Jeff Immelt, CEO of GE, said, “innovation and supply chain strength gets developed where the demand is the greatest."[22]

A national clean energy standard would help provide the long-term certainty needed for innovators to invent, investors to mobilize capital, and manufacturers to scale production. The resulting ramp up of a domestic supply chain of innovation and investment would, in turn, help continue the significant and sustained downward trajectory of prices for clean electric generating capacity – providing American consumers with an expanded menu of affordable electricity options and moving key clean energy technologies to grid parity (cost-competitiveness) with conventional energy sources. Price declines should, over time, allow the federal government to gradually reduce tax credits and other incentives intended to help the industry establish itself in the marketplace.

In developing legislation to establish a national clean energy standard, policymakers will consider a variety of design considerations. For example, the clean energy standard can be narrowly targeted toward renewable energy sources, or more broadly construed to include energy efficiency, carbon capture and storage technologies and cleaner-burning natural gas. The design of a national clean energy standard should also account for practical realities, such as different levels of clean energy potential in different regions. In addition, policymakers should consider adopting certain measures that encourage flexibility and lower costs, such as trading mechanisms and exemptions for small electric entities.

Policy Recommendation #2: Invest in Clean Energy Innovation

America has a clear advantage in clean energy innovation that must be maintained. Our competitive future hinges on the ability to maintain a pipeline of ideas and innovations for driving down the cost and ratcheting up the performance of advanced clean energy technologies.

The public sector has a special role to play in clean energy innovation because the intensity of international competition in the energy industry limits the ability of the private sector to undertake research and development. The U.S. national labs and university research capabilities provide the foundation for basic and applied energy research that is fundamental to developing advanced energy technologies in conventional and emerging sectors. Consistent and ample funding for federally-supported research at national laboratories and universities is essential to our long-term competitive position.

In recent years a broad variety of expert commissions and panels have looked at the scale and scope of U.S. energy research efforts. These have included the President's Council of Advisors on Science and Technology (PCAST); the American Energy Innovation Council (AEIC) comprised of distinguished American business leaders; and academic panels such as Harvard University's Belfer Center for Science and International Affairs. While there are different points of emphasis in the findings published by each of these panels, the overarching conclusion is the same – the United States is substantially underinvesting in energy research. The consensus view is that energy research and development funding should be increased by two to five times over the FY2012 level of $4.36 billion.[23]

Expert studies and our roundtable discussions demonstrate considerable support for the current direction and structure of both basic and applied U.S. energy research and development efforts.

Relatively new initiatives such as the network of Energy Frontier Research Centers for basic research and Energy Innovation Hubs for applied research are widely applauded. The Advanced Research Products Agency – Energy (ARPA-E) garners consistent high praise for its mission orientation and effective project priorities.

Policy Recommendation #3: Reinforce Incentives for Private Investment

Given the centrality of energy to the economic and security interests of the United States and the quality of life of the American people, government policy has long provided incentives to help advance energy development and services. More recently, the federal government has offered production and investment tax credits for qualified clean energy technologies. For all intents and purposes, these credits have been utilized primarily since the mid-2000s, when clean energy deployment reached commercially relevant levels. And they have worked – stimulating investment, deployment, manufacturing and helping drive the cost of technology down. But unlike some permanent tax incentives in other parts of the energy industry, the production and investment tax credits are clouded in uncertainty on an almost annual basis, creating a boom and bust investment environment that retards consistent progress.

To preserve the competitive viability and emergence of the U.S. clean energy sector, industry leaders urge policymakers to provide a long-term renewal of the production and investment tax credits. Several participants called for use of "shallow incentives" for technologies that are close, but need help getting over the line to cost-competitiveness. But participants in the roundtable process also noted that these tax credits cannot and should not go on forever.

With these considerations in mind, roundtable participants suggested that policymakers consider a multi-year but time-limited extension of the production and investment tax credits for clean

energy sources. In light of industry statements that cost-competitive clean generating capacity can be foreseen in this decade, an extension through 2020 would help foster cost-competitiveness, provide certainty and give industry the necessary lead-time to prepare for a post-subsidy world.

Policy Recommendation #4: Level the Energy Playing Field

There are a wide variety of economic, regulatory and legal barriers that favor incumbent technologies over those jockeying for a place in the marketplace. These barriers threaten the ability of new companies and technologies to gain a competitive foothold. Moreover, they block from consumers new technologies that can inject choice and competition, help lower prices and improve product offerings.

If barriers are eliminated, broader pools of private capital can be leveraged through innovative financing mechanisms that help lower the cost of capital. For example, master limited partnerships (MLP's) provide incentives for investors to help finance construction of domestic energy infrastructure. Investors can access these opportunities through equity markets and qualify for certain tax advantages. MLP's mobilize large reservoirs of low cost capital for oil and gas interests, but the law does not allow clean energy businesses access to these sources of finance.

In addition, there is an ITC available to a suite of industrial and institutional efficiency technologies, however, waste heat to power technologies are excluded. This method of capturing heat from an industrial process and turning it into power has the potential to generate 10 GW of additional energy making U.S. manufacturing more efficient and productive.[24]

There are also other advantageous legal arrangements that can be opened up to clean energy interests. At several of our roundtables, participants expressed support for allowing real estate investment trusts (REITS) to finance renewable energy projects. REITs are corporate entities that receive certain tax benefits in exchange for investing in income-producing real estate. These vehicles allow small investors to participate and mobilize large amounts of capital in real estate development. By qualifying renewable energy infrastructure as an eligible source of REIT financing, any investor would be able to purchase shares in a portfolio of renewable energy projects.

Policy Recommendation#5: Support U.S. Clean Energy Manufacturing

Clean electric generation technologies represent an emerging opportunity for America's high-technology manufacturers. Industry and economic development leaders are pursuing a range of initiatives to spur manufacturing in the clean energy sector, such as enacting renewable portfolio standards that stimulate demand; helping innovators and entrepreneurs grow businesses; and creating clusters of scientists, investors and business leaders to transition ideas out of laboratories into businesses that are supported and nurtured to success.

The federal government can also play a role in fostering renewable energy manufacturing at this critical time in the emergence of the U.S. and global marketplace. In recent years, one of the primary efforts to stimulate clean energy manufacturing was the Advanced Energy Manufacturing Tax Credit, also referred to as Section 48C of the Internal Revenue Code, authorized in 2009 as part of the American Recovery and Reinvestment Act. In an attempt to supply clean energy projects with components made in the United States, the Section 48C program provided a 30 percent credit for investments in clean energy domestic manufacturing

facilities capable of producing renewable energy equipment, energy storage systems, carbon dioxide capture and sequestration equipment, electric grids, energy conservation technologies, and other clean energy products. $2.3 billion in tax credits were granted to domestic projects for the 48C program, leveraging an additional $5.4 billion in private sector investment.[25] Experts also estimate that the tax credit directly created 17,000 jobs and that associated private investment supported roughly 41,000 additional jobs.[26] More than 180 manufacturing projects were supported in 43 states. Applications for the 48c credit far exceeded the program budget, which was exhausted in 2010.

Earlier this year, the Department of Energy initiated the Clean Energy Manufacturing Initiative (CEMI), to help boost U.S. competitiveness and manufacturing in the sector. This innovative public-private partnership should also help build the domestic supply chain and our long-term economic success in the sector.

Policy Recommendation #6: Expand Markets for U.S. Clean Energy Goods & Services

Long-term forecasts of electricity growth and clean energy markets demonstrate that the vast majority of future investment will occur in emerging economies and developing nations.

Markets for clean energy goods and services will grow as nations work to close the gap between the energy "haves" and "have-nots". An estimated 1.5 billion people around the world currently lack access to modern electric services.[27] Billions more have only limited, intermittent electric service or rely on wood, charcoal, and diesel generators for heat and cooking. Collecting or purchasing this fuel is burdensome to the energy poor. And extending electric infrastructure is an enormously expensive proposition. Clean energy offers the opportunity for communities to leapfrog the era of electric wires in the same way that cell phones have allowed these same

communities to bypass the era of hard-wired phones. In addition, some countries see opportunities in switching to renewable energy. Saudi Arabia, for example, plans to invest more than $100 billion in solar energy as a means of obtaining 30 percent of its electric needs through renewable energy over the next 20 years.[28]

In recent years, the United States has enhanced efforts to support renewable energy exports. According to the Department of Commerce, renewable energy exports increased from $1.3 billion in 2007 to $2.1 billion in 2009.[29] During that period, wind energy exports increased by 29 percent annually and biomass equipment and feedstock trade increased by 54 percent.[30]

To help coordinate and expand U.S. clean energy efforts as part of the National Export Initiative, the Trade Promotion Coordinating Committee, an interagency working group chaired by the Secretary of Commerce, has created a Renewable Energy and Energy Efficiency Export Initiative (RE4I). This initiative seeks to mobilize financing that supports exports by U.S. companies; open international markets to U.S. clean energy goods and services; and promote trade opportunities overseas. Twelve agencies participate in the RE4I initiative.

In recent years, some of the key export assistance arms of the U.S. government have stepped up efforts in the clean energy sector. The Export-Import Bank has dramatically increased its renewable energy portfolio, which doubled to $721 million between fiscal 2010 and 2011.[31] Likewise, the Trade and Development Agency has doubled its programmatic focus in the renewable energy arena. [32] And the International Trade Administration at the Department of Commerce has established a Renewable Energy and Energy Efficiency Advisory Committee to help bring private sector ideas into the federal government's export initiatives in the sector.

In view of the significant growth and potential of clean energy markets and emerging international trade issues in the sector, the United States Trade Representative has asked the International Trade Commission (ITC) to do a thorough review of the renewable energy services market.[33] The last ITC review of renewable energy and trade was conducted in 2004-05, when global investment was a fraction of what it is today. The ITC assessment, due to be completed later this summer, should give U.S. government agencies and policymakers useful guidance on the scale of clean energy markets, key sectors for U.S. priority and priority export markets for U.S. industry.

CONCLUSION

After several decades in laboratories and niche applications, clean energy technologies are primed for accelerated and widespread expansion in the world's power sector. In the United States and around the world, solar, wind and other renewable energy sources will represent a significant share of the new generating capacity deployed in the coming years and decades. These technologies will also be in demand as the world addresses persistent and emerging local and global environmental challenges. Finally, we know that clean energy will be sought after in the push to achieve greater energy security.

For all these reasons, the future of clean energy is bright. Less certain is the forecast for the United States' competitive position in this fast-growing sector. On a variety of key measures – from innovation to manufacturing to deployment to exports – the United States is struggling to maintain a position of leadership in the global economic and technological race.

Discussions with industry and other experts across the United States reveal tremendous frustration about the inability of American interests to capitalize more fully on the emerging

clean energy moment. Having invented and brought to market many of the prevailing clean energy technologies, U.S. scientists and entrepreneurs now find themselves buffeted by disparate national and international forces.

The United States has a proud history of public-private partnership in advancing national competitiveness in key sectors – from railroads and automobiles to telecommunications and conventional energy sources. In view of current and projected investment trends, U.S. competitiveness in clean energy warrants similar priority and partnership.

Above all else, industry and other practitioners in the clean energy field desire some degree of long-term policy certainty. These leaders are highly confident of the ability of American industry to succeed as the clean energy marketplace expands at home and around the world – provided there is consistency and consensus in policy along the lines outlined in my testimony.

Policies that encourage the deployment, innovation, manufacturing and trade of clean energy technologies will help bolster the competitive prospects of American industry. As Congress considers revisions to the tax code, Pew hopes to highlight that clean energy policies will enhance the nation's economic, environmental and national security prospects. The Pew Charitable Trusts is committed to working with public and private sector leaders to realize these goals.

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