TESTIMONY OF NEIL Z. AUERBACH, MANAGING PARTNER OF HUDSON CLEAN ENERGY PARTNERS, BEFORE THE COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE MARCH 17, 2011 on CURRENT GLOBAL INVESTMENT TRENDS IN CLEAN ENERGY TECHNOLOGIES AND THE IMPACT OF DOMESTIC POLICIES ON THAT INVESTMENT

Mr. Chairman, Ranking Member, members of the committee, thank you for the opportunity to testify here today. It is truly an honor.

My name is Neil Auerbach, and I am the Founder and Managing Partner of Hudson Clean Energy Partners. Hudson Clean Energy Partners is a global private equity firm that focuses exclusively on investing in the clean energy sector. With over $1 billion in assets under management, Hudson is a leading global investor in sectors that include wind, solar and hydroelectric energy, biofuels, biomass, smart grid, electric vehicles, energy efficiency and storage. Given our position on the front lines of these fast-growth industries, we have seen firsthand the impact of government policies on our sector, both at home and abroad. I would like to offer some observations about how government policy impacts private sector capital flows, and then offer some suggestions as to how the United States can become a more attractive place to invest, create jobs and generate wealth through adoption of smarter policies. Before I begin, however, I would like to summarize the reasons why encouraging the growth of the clean energy sector is of paramount importance to the United States.

Why the United States has a compelling interest in clean energy[1]

Increased manufacturing and deployment of clean energy in the United States serves three compelling national interests: (1) energy security; (2) environmental protection; and (3) economic growth. No other part of the energy industry can lay claim to impacting so many fundamental interests of the United States. To date, the policy response of the United States has not adequately supported a sector critical to so many fundamental national interests. Much impassioned rhetoric has been intoned in debates about the merits of supporting one part of the energy industry or the other. I am not here today as an opponent of any part of the energy industry, including the coal, oil, natural gas and nuclear industries. I am a realist. Dreams are not part of my investment thesis, and I harbor no illusion that any clean technology breakthrough can, will or should eliminate any of these industries. Furthermore, as an investor, I understand the value of

[1] The term "clean energy" has many definitions, as many industries want the moniker of being called "clean." Here, I used the term to refer to renewable energy (wind, solar, biomass, geothermal, hydropower, biofuels) and energy smart technologies (including smart grid, building efficiency, industrial efficiency, transport efficiency and storage).

portfolio diversification. If we have learned anything about energy over the past decade, it is the importance of maintaining an adequate, diversified supply of energy. As an advocate of, and leading investor in, the clean energy field, I heartily recommend an "overweight" to the clean energy sector. My view is that a more fulsome understanding of why increased investment in clean energy is of such vital national importance can better inform the important dialogue about the most appropriate means to do so.

The benefit of clean energy to U.S. energy security should be obvious, but it warrants discussion anyway. In our transportation sector, dependence on foreign oil weakens our national security. I have nothing new to add to clarify what is already abundantly evident. However, what might not be so clear to this Committee is the progress being made in the search for long term replacements for oil as the primary energy source for our transportation sector. Currently, the two most viable, long term replacements for oil are biofuels and hybrid/electric vehicles.

While second generation biofuel technologies have not matured to a point where the cost curve could be definitively predicted, major corporations in the energy space, including Chevron and ExxonMobil, have made significant investments in these technologies. As an example, ExxonMobil plans to invest as much as $600 million in algae-based biofuel production, with a significant percentage going to Synthetic Genomics, a California-based firm whose CEO is Craig Venter, one of the human genome decoders. Some expect genomic science to be the key to yielding a significant decrease in the cost of the biofuel production cost curve. A more mature field is the Electric Vehicles ("EV") market, where we have seen volumetric energy density of lithium-ion batteries, the most expensive component of a hybrid/electric vehicle, improve by a factor of 2 and cost decline by more than 70% during the last ten years. As production of these components scales, the cost is expected to decline by another 70% by 2015.

If you accept the premise that there is a progress curve at work reducing the cost of advanced batteries powering the next generation of our transportation fleet, then smartly crafted incentives that accelerate deployment of hybrid/electric vehicles serve a national goal of improving energy security by reducing the dependence of the United States on foreign oil. Admittedly, the truth is a bit more complex than that, as we need to understand better the vulnerabilities of the U.S. power grid as it accommodates its new electric vehicle fleet, as well as the vulnerability of the supply chain of electric vehicles, particularly as it pertains to the lack of globally distributed supply of rare earth minerals.

Increased investment in clean energy clearly improves U.S. energy security in the power sector as well. The tragedy unfolding in Japan has put a spotlight on the security risks associated with nuclear power, as well as the environmental risks.[2] A nuclear power plant seriously damaged by a natural disaster may take years to rebuild, even if the damage causes no harmful radiation to escape into the atmosphere. The aftermath of Hurricane Katrina illustrates the vulnerability of many of our nation's natural gas wells and pipeline infrastructure.[3] Renewable energy sources, particularly wind and hydro, have a long history of safe and reliable operation and are far less vulnerable to massive disruption. For example, most wind turbines are designed to stop spinning in a hurricane, and are designed to withstand winds in excess of 150 mph.

Improving our environment has been a national goal and has been enshrined in numerous pieces of legislation, most notably, the Clean Air Act of 1970, amended in 1990, and the Clean Water Act of 1972. In this regard, the nation continually searches for more environmentally friendly methods to utilize its resources for energy production. Not only does clean energy reduce the harmful environmental impact associated with elevated levels of greenhouse gases, it also offers the best way to reduce other harmful pollutants in our atmosphere such as carbon monoxide, sulfur dioxide, oxides of nitrogen, particulates, volatile organic compounds and hazardous air pollutants (e.g. mercury).

Finally, investment in clean energy promotes economic growth. The clean energy market is forecast to triple in size during this decade, from $740 billion to over $2 trillion, exceeding global GDP growth even under the most conservative growth scenario.[4] The U.S. currently accounts for 21% of the clean energy market, but its pole position is under competitive threat. China, which now accounts for 17%, is expected to rise to account for 24% of the global clean energy market by 2020. As is written in an old Chinese proverb, it is impossible to stay in one's current position in a rapidly moving river. Either one paddles hard to move ahead or one will be washed back.

Many critics of clean energy express concern about the elevated cost of clean energy technologies as compared to their fossil fuel counterparts, and posit that any support of alleged uneconomic industries cannot possibly foster economic growth over any prolonged period of time. Others focus on the small installed base of clean energy technologies and wonder whether any of them can ever reach the scale necessary to make a meaningful contribution to our long term energy supply.

Both concerns are utterly misplaced, and the underlying myths must be exposed. All conventional energy sources used for our electricity grid have begun as very expensive power sources and have only gotten cheaper as economies of scale have kicked in. Figure 1, which comes from an article published by my

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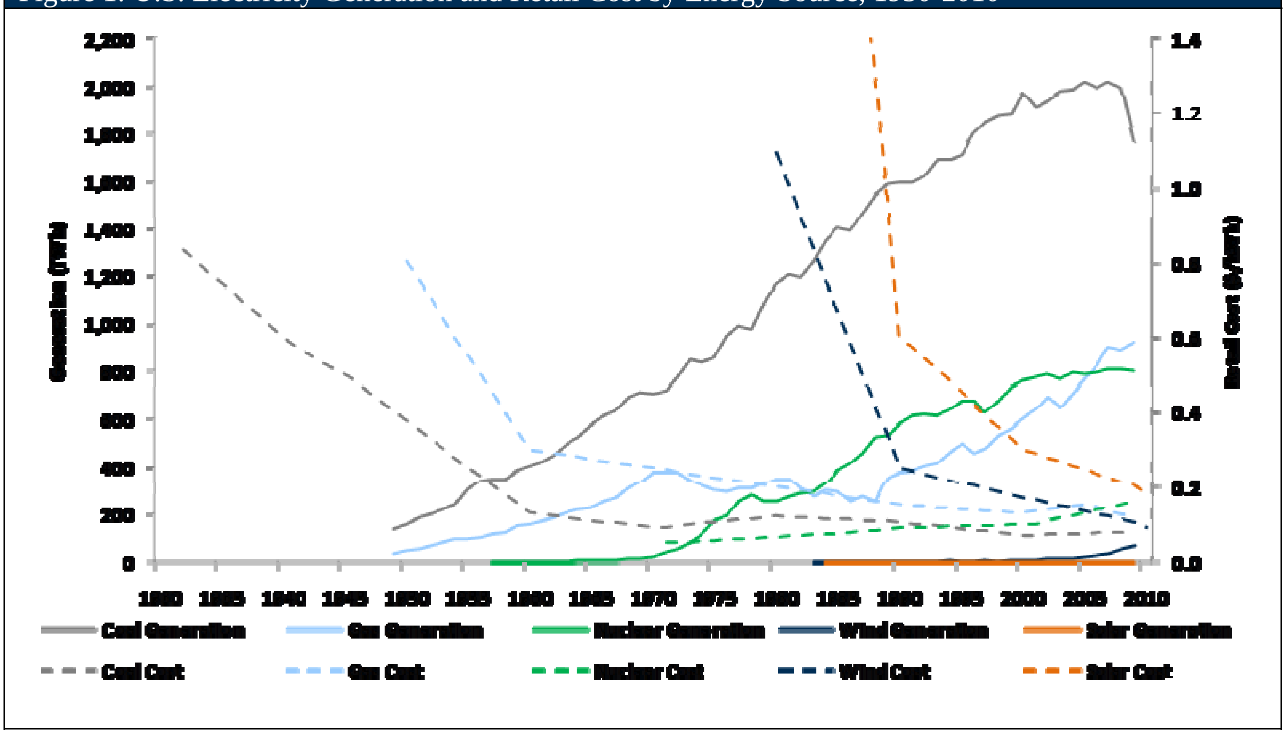
[2] I am not an expert in the nuclear power field, and offer no opinion on an appropriate policy response to the concerns being raised about the safety of our nuclear fleet in the wake of Japan's national disaster.
[3] The natural gas supply disruption resulting from Hurricane Katrina cost the consumer approximately $8.5 billion in higher natural gas prices during the 45 day price spike that followed the hurricane, exclusive of the cost of replacing damaged infrastructure.
[4] HSBC Global Research, "Sizing the climate economy", September 2010.

colleagues in the Journal of Environmental Finance,[5] catalogues the history of price movements of electricity powered by coal, natural gas, and nuclear energy since 1930. History teaches us that each of these power sources has required achieving massive scale in order to achieve their current favorable cost structures.

Hudson's research uncovered that the slow improvement in cost structure accompanying massive increases in scale is not taking place in the wind and solar industries. Rather, *small increases in scale are causing significant improvements in their cost structures.* Figure 1 clearly demonstrates that wind and solar energy have reduced cost more rapidly than any other type of conventional energy source over the last 80 years.

Figure 1: U.S. Electricity Generation and Retail Cost by Energy Source, 1930-2010



Sources: U.S. Energy Information Administration; Massachusetts Institute of Technology; American Energy Independence; US National Renewable Energy Laboratory; "The Economics of Nuclear Reactors: Renaissance or Relapse", Cooper, 2009; Hudson estimates

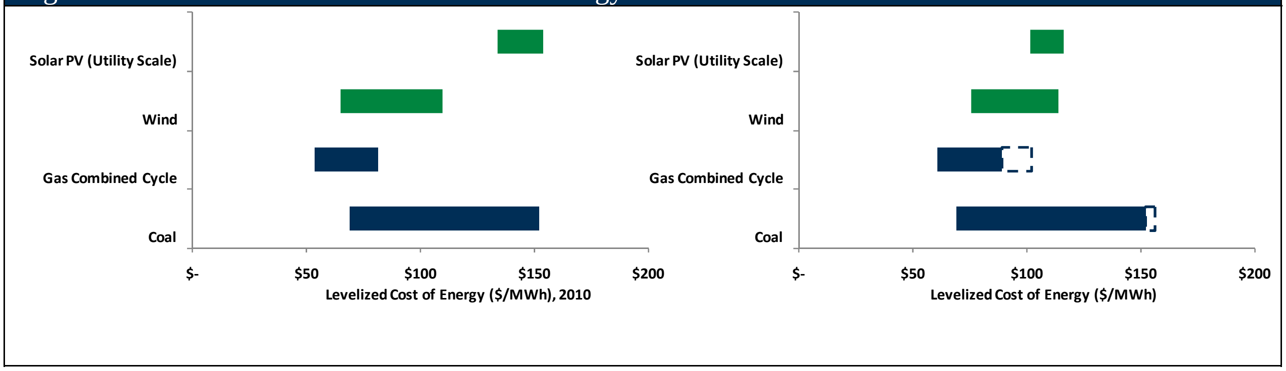
The rapid reduction in clean energy's cost structure is projected to continue, and will bring these technologies into grid or retail parity with conventional power sources over time, even cheaper than conventional power sources in more and more markets over time.

An annual survey of cost competitiveness of various forms of electricity generation conducted by Lazard confirms this view. Figures 2 and 3 compare the wholesale and retail power prices for several clean and conventional power sources, and shows their expected cost migration from 2010 to 2015. Most striking is

[5] Environmental Finance, "Making the Case for Clean Energy", December 2010 - January 2011

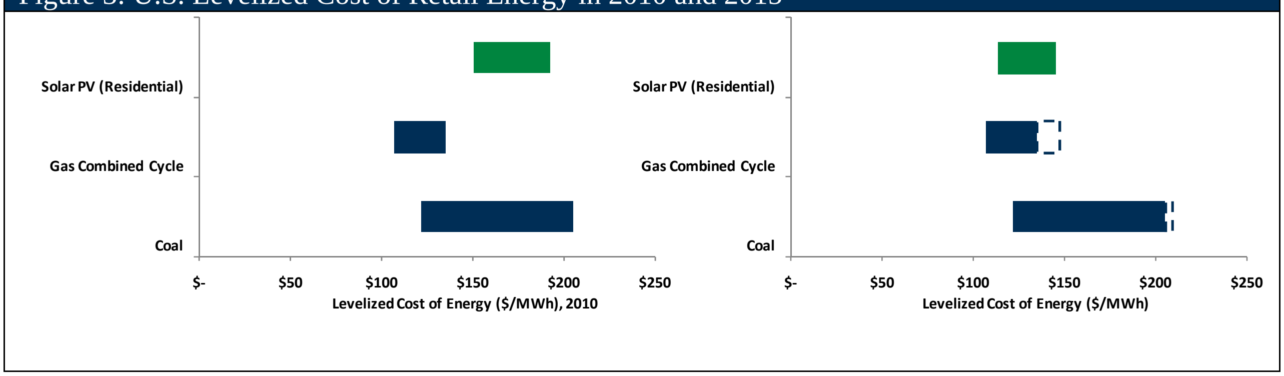
the forecast of rapid cost declines for solar power. Data sources point to solar panel price declines of approximately 50% over the past two years.[6] Lazard's cost forecasts for the wind industry are probably conservative, and do not adequately account for intense price competition underway in the wind turbine market that have resulted in cost declines exceeding 20% over the past 3 years. Significant further price declines are expected as leading Chinese wind turbine manufacturers with lower cost structures, as well as newer wind turbine models sporting improved wind turbine efficiency, enter global markets.[7]

Figure 2: U.S. Levelized Cost of Wholesale Energy in 2010 and 2015



Sources: "Levelized Cost of Energy Analysis – Version 4.0", Lazard, June 2010; Hudson estimates
Notes: Solar PV assumes conventional silicon modules; gas assumes $4/MMBtu in 2010 and $5/MMBtu in 2015. Dotted lines include carbon tax of $30/ton.

Figure 3: U.S. Levelized Cost of Retail Energy in 2010 and 2015



Sources: "Levelized Cost of Energy Analysis – Version 4.0", Lazard, June 2010; Hudson estimates
Notes: Solar PV assumes conventional silicon modules; gas assumes $4/MMBtu in 2010 and $5/MMBtu in 2015; retail energy for gas and coal incorporate a $53/MWh cost of transmission and distribution. Dotted lines include carbon tax of $30/ton.

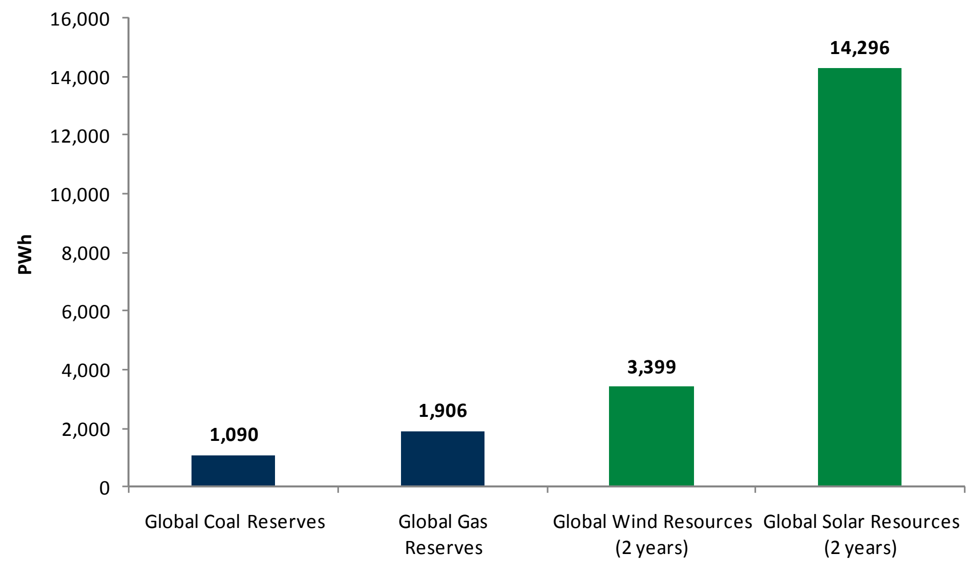
The concern I mentioned earlier about the scalability of clean energy technologies is easily dismissed and I won't spend much time debunking the myth. The wind industry today installs approximately 38 GW of wind turbines globally every year. The solar industry has grown exponentially over the past 7 years since I entered the industry. Only 1 GW of solar panels was installed in 2004. Last year, nearly 17 GW of solar panels were installed globally, and the industry is forecasting annual installations of solar panels in

[6] Hudson estimates
[7] Emerging Energy Research and market quotes from OEMs

excess of 40 GW by 2014. By comparison, approximately 50 GW of nuclear power were installed from 1990 to 2007.

No one needs to be concerned about the world's access to commercially utilizeable wind and solar resources. Figure 4 should allay any concern that we're running short on either resource any time soon.

Figure 4: Power Potential of Global Natural Resources



Sources: BP, Chatham House, U.S. Department of Energy, Physics Factbook, Hudson estimates

If the importance of clean energy to vital national interests is so clear, and the improvements in the cost structure of various clean energy technologies is so rapid, why am I here advocating for increased federal support for clean energy? There are essentially three reasons: (1) innovation is not integral to the energy industry; (2) the degree of federal support for clean energy is not commensurate with its strategic importance, as discussed above; and (3) I sense that the federal government may not be fully aware of the competitive environment in which other countries are demonstrating greater commitment as well as skill in supporting the growth of clean energy manufacturing and deployment within their borders.

<u>Energy is a commodity, not a consumer product</u>

Energy is a commodity that affords consumers little opportunity to express a preference in where it originates or how it is produced. The market lacks a demand function that allows producers to supply different products with different cost structures, as for example, in the case of consumer electronics, where consumer preferences drive manufacturers to invest in innovation and product diversification. In electricity markets, there is baseload power, peak power, and off-peak power at the wholesale level. At the retail level, there is the light switch, and in certain markets, the ability to express some preference in how to buy electricity through smart meters.[8] In the absence of a market incentive to encourage investment in new energy sources other than that needed to meet new demand or obsolete supply, newer technologies have a hard time getting to scale.

As pointed out by The American Energy Innovation Council in its inaugural 2010 report[9]:

> There are two reasons the government must play a key role in accelerating energy innovation.
>
> First, innovation in energy technology can generate significant, quantifiable public benefits that are not reflected in the market price of energy. These benefits include cleaner air and improved public health, enhanced national security and international diplomacy, reduced risk of dangerous climate change, and protection from energy price shocks and related economic disruptions. Currently, these benefits are neither recognized nor rewarded by the free market.
>
> Second, the energy business requires investments of capital at a scale that is beyond the risk threshold of most private-sector investors. This high level of risk, when combined with existing market structures, limits the rate of energy equipment turnover. A slow turnover rate exacerbates the historic dearth of investments in new ideas, creating a viscous cycle of status quo behavior.[10]

<u>Global investment in clean energy is surging</u>

When I entered the clean energy sector in 2004, global investment in our sector was approximately $50 billion. In the last seven years, global investment in clean energy surged fivefold to nearly $250 billion, over 30% ahead of 2009. In 2004, the United States was the destination for approximately 20% of the clean energy capital invested in the sector, while China accounted for just 3%. Last year, however, the United States dropped to 19% of global clean energy investment, and China recorded over 20% of that investment.

Our international trading partners, conspicuously led by China, are laying plans for massive investments in the clean energy sector. They are witnessing the dramatic growth of vibrant markets for clean power and energy smart technologies, such as smart grid, ultra high capacity transmission, advanced energy

[8] For example, smart meter rollouts in selected regions across the country offer customers Time of Use pricing.
[9] American Energy Innovation Council, "A Business Plan for America's Energy Future", 2010.
[10] The report points out that research & development spending as a % of sales is 18.7% of the pharmaceuticals industry, 11.5% of aerospace and defense, 7.9% of computers and electronics, 2.4% in automotive and 0.3% of the energy industry.

storage, LED lighting, and electric vehicles, as they seek to address the energy infrastructure needs of their own economies while nurturing the growth of export-driven industries.

Other countries have succeeded in attracting significant amounts of capital for investment in manufacturing and deployment, and have used a wide variety of policy tools to attract that capital. Although the types of policy tools employed by countries to accomplish their clean energy goals vary widely, most of the policy tools fall into the following four categories: (i) installation mandates or targets; (ii) revenue incentives; (iii) manufacturing incentives; and (iv) financing incentives.

Installation Mandates and Targets

Three of the most active countries last year in attracting capital for deployment of clean energy had either a mandate imposed on utilities or grid operators, or targets that had the respect of both the private and the public sector. China leads the world in both the pace of new policy adoption as well as the scale and scope of its ambition. New clean energy targets include (i) 15% renewables in primary energy consumption by 2020, and (ii) 35% - 40% energy intensity reduction by 2015 from 2005 levels. In gigawatt terms, China seeks to deploy roughly *7.6 times* the amount of clean energy in 2020 as compared to its 2009 levels.

While federal policy toward clean energy has not kept pace with other countries, the United States has benefitted from a wide range of state and local policy incentives directed at financing the scale-up of clean energy. Texas, California and New Jersey represent the top three U.S. states in terms of installed renewable energy capacity, with their combined installed capacity exceeding one-third of the U.S. total. California leads the country with a 33% Renewable Electricity Standard (“RES”) by 2020, an active Renewable Energy Credit (“REC”) market, the California Solar Initiative and state feed-in tariffs. Texas has implemented a mandate to produce 5.9 GW of renewable energy by 2015 and 10 GW by 2025. New Jersey has set a target of reducing greenhouse gas emissions 80% from 2006 levels by 2050.

Leading the way in Europe, Germany has set an accountable target to achieve 80% of electricity from renewable sources by 2050 while also adhering to the EU’s 20% by 2020 target.

Revenue Incentives

Revenue incentives have been one of the most popular and impactful policy tools to stimulate investment in clean energy deployment. Some of the more popular tools have been feed-in tariffs[11], renewable energy credits[12], tax credits, and carbon credits. Several of these policy tools have been criticized, most notably feed-in tariffs, as overly generous in cases where Government agencies have attempted to set market prices based on often-outdated information about the rapidly evolving industry cost structure. For example, in Spain, a generous feed-in tariff of approximately €455/MW hour for solar power resulted in a building boom of over 3,200 MW of solar capacity over a two-year period between 2007 and 2008, representing over 35% of the global solar market at the time. Gross margins for various suppliers of solar panel components exceeded 80% for some companies taking advantage of the Spanish Government's largesse, until Spain fitfully redrafted its feed-in tariff rules in late September of 2008, causing massive dislocations in the global supply chain.

A much more market friendly and disciplined form of revenue support has gained considerable traction. Reverse auctions, used successfully in many other industries, have recently been used with great success in Brazil, in place of its former feed-in tariff system, to auction off nearly 2.1 GW of wind energy tenders, and resulted in a 42% average price drop in the price paid for wind energy in comparison to the feed-in tariff previously in force.[13] In concept, reverse auctions are simple. They are auctions conducted by buyers to encourage sellers to sell at the lowest possible price. In practice, reverse auctions require careful planning to ensure a successful outcome.

As this Committee considers how to support the accelerated deployment of clean energy in the United States at the lowest possible cost to the Government and consumers, reverse auctions are a compelling option. I will discuss the benefits of this approach for the U.S. later in my testimony.

Manufacturing Incentives

Incentive programs in foreign countries for the deployment of clean energy have made relocating U.S. manufacturing facilities overseas extremely attractive. In China, Malaysia, Brazil and others, mechanisms such as free-trade zones, long-term tax holidays, cheap electricity, accelerated permitting and cash grants have led to increased clean energy deployment as well as meaningful job creation.

To achieve installation targets, some governments explicitly require a certain amount of domestic content to drive manufacturing. China and the Province of Ontario have employed competitive domestic content

[11] For example, Spain, Germany, China, UK and Ontario Province, Canada
[12] Includes RECs in various states, green certificates (Italy), renewable obligation certificates (UK)
[13] Bloomberg New Energy Finance, "Wind Tender Analysis in Brazil: Winner's Curse?", September 2010

rules to maximize job creation from domestic subsidy programs, which has attracted substantial domestic and foreign capital to these areas. China has implemented a 70% local content requirement, which has forced some of the largest players to build manufacturing hubs in these areas.

In the United States, we have been fortunate to have the manufacturer's tax credit (MTC) under section 48 (C) of the Internal Revenue Code. One of Hudson's portfolio companies, Calisolar, has been awarded a $51 million MTC for its solar cell manufacturing facility in Sunnyvale, California. That manufacturing facility has been built, in part, with the proceeds of that MTC award. It is important to note, however, that Calisolar faced a challenge in utilizing all of the MTC that many other recipients of the MTC probably faced. The MTC program assumes that the award recipient pays current federal corporate income tax, since the award entitles the recipient to reduce its federal income tax liability. Many young, innovative companies simply haven't matured sufficiently to generate the level of profitability needed to incur a tax liability against which to apply the MTC. Instead, these companies must hire brokers, accountants and lawyers to identify other companies that pay tax and would be willing to "pay" to "buy" the credit, so that the award recipient receives the intended economic benefit. One suggestion for improvement of the MTC program is to allow award recipients to apply to the Treasury Department to receive the award in cash, much like the current 1603 program for the investment tax credit. Administrative guidelines have been established that permit taxpayers to rely on the transparency of the procedures that must be followed to claim the credit, while providing the Government with an efficient oversight mechanism so that the cash paid in lieu of the credit goes to the intended recipient.

Financing Incentives

A key enabler of both clean energy deployment and manufacturing has been the provision of financing and financing assistance from public funding sources. The clean energy industry is very capital intensive. Renewable technologies, in particular, effectively convert operating expenses normally incurred over 30 or more years (e.g., fuel costs) into up-front capital expenditures for the installation of the generation equipment. For example, a combined cycle gas plant can be built for approximately $1,000 per kilowatt of capacity, whereas a wind farm requires approximately $1,900 per kilowatt to install, and a solar plant requires approximately $3,000 per kilowatt to install.[14] Access to reasonably priced capital is critical to ensure that clean energy manufacturing and deployment can take place at low cost and on time.

In this regard, the United States has struggled to keep pace with many of its international trading partners. For example, in 2010, the Federal Financing Bank supplied over $2 billion in financing to the clean energy sector, whereas China Development Bank supplied over $35 billion in financing to its clean

[14] In the case of wind and solar energy, once the plant is built, the fuel is free.

energy sector.[15] In Germany, KfW, a state-owned bank, loaned €9.6 billion to the clean energy sector. In the United States, nearly $46 billion was invested in the clean energy sector in 2010, of which approximately 10% received federal financial assistance, primarily in the form of loan guarantees.

International support is growing for the provision of financing incentives, and there is no evidence that China Development Bank intends to slow down its pace of capital commitment to the sector. For example, the UK is seriously examining the support for a "green bank" that will act as a lender to and guarantor of private market participants in their domestic clean energy industry.[16]

The case for continuing federal support for clean energy manufacturing and deployment in the U.S. is clear

I acknowledge that the United States desperately needs to put its financial house in order, and that the size of the federal budget deficit will constrain its ability to spend money in the pursuit of its interests. I also acknowledge that the realm of government accounting is not an expertise that I possess, and so the ultimate choices made by this Committee in advancing legislation is likely to be shaped by budgetary rules and limits that I simply cannot anticipate. With those caveats, I believe that the United States cannot afford to cede technology leadership in one of the world's fastest growing sectors that addresses so many core national interests any more than it can afford to spend the taxpayers' money far faster than it collects it. But in this climate of budgetary constraints, I also believe that there are approaches that can be taken to promote clean energy that do not impose a material burden on the federal government.

It seems implausible to me that the United States can again enjoy sustained periods of brisk economic growth without producing high value goods and services domestically that are in demand both here and abroad. The ability of the United States to compete effectively in key industries is in peril in the absence of bolder leadership by the federal government. Below, I discuss the importance of existing federal programs and the need to think more broadly about the direction of future policy.

<u>Historical Perspective: the Development of Solar PV Manufacturing</u>

Though Asian manufacturers dominate the solar industry today, the solar industry was born in the United States, and U.S. firms led the world for decades. Sadly, and quite avoidably, the center of gravity moved abroad at precisely the time the solar market began to take off. Why? Largely because other countries created attractive policy incentives to promote local demand and local manufacturing.

[15] Bloomberg New Energy Finance, "China Development Bank – How It Came to Be a Giant Lender to Clean Energy", 11 March, 2011
[16] Green Investment Bank Commission, "Unlocking Investment to Deliver Britain's Low Carbon Future"

Scientists at Bell Laboratories developed the first crystalline silicon photovoltaic cell in 1954. Four years later, the U.S. Vanguard space satellite carried a small array of PV cells to power its radio.

The U.S. market for solar energy systems grew in the early 1980s in response to federal and state programs and incentives such as income tax credits, property tax exemptions, sales tax exemptions, cost-sharing grants, government purchasing programs, and government-funded demonstrations. In 2004, before the solar industry began its most recent dizzying growth spurt, the United States was the home to approximately 10% of the world's solar manufacturing capacity. Today, only around 6% of worldwide PV cell production takes place in the United States and approximately 59% of global cell production takes place in China[17].

In late 2005, I spearheaded the pre-IPO investment made by Goldman Sachs into First Solar, which today is the world's most successful solar company. Although First Solar is based in the United States, most of its solar panels are manufactured outside of the U.S. Time will tell if my prior investment success will be repeated with the two solar companies currently in Hudson's portfolio. That being said, I am convinced that both companies have the technology promise and the cost discipline to emerge as leading contenders in the next wave of great solar companies that is emerging in this fast-growing industry. What is important to note for this Committee is that both companies have expressed a strong interest in locating their next manufacturing facilities in the United States, and that the Loan Guarantee Program is of critical importance to each company's decision.

Calisolar is a California-based manufacturer of silicon, wafers and cells that are sold to manufacturers for use in making solar panels. Calisolar is unique in its ability to manufacture silicon feedstock that is much cheaper than conventional silicon without compromising quality. With manufacturing scale only a fraction of its more established competitors, Calisolar is manufacturing its silicon far cheaper than most of its industry peers. And in an all-too-rare industry role reversal, our American company is exporting its product to China. When Calisolar builds its first large-scale manufacturing facility, we believe it will be the lowest cost manufacturer of silicon in the world.

Facing the choice of whether to locate this large-scale manufacturing facility in the U.S. or elsewhere, Calisolar sought out the best incentives available. The most compelling incentives to build a plant in the U.S. have come from individual states seeking to attract new jobs. State incentives have included: preferred power prices, low-cost land and buildings, free trade zones, grants for job training, and assistance with permitting and necessary approvals. Asian countries are currently offering similar incentive packages and access in the U.S. through the Loan Guarantee Program to the type of low cost

[17] Solarbuzz 2011

financing offered by many Asian nations would help a company in Calisolar's position to choose to locate its next manufacturing facility inside of the U.S.

Another example of how the Loan Guarantee Program is helping companies in our portfolio select the United States as the home of their next manufacturing facility is SoloPower. SoloPower is a California-based manufacturer of unique lightweight, flexible, high-power solar panels that possess critical advantages for both rooftop and ground mount solar market applications. By flexible, I mean thin, bendable, and utterly unlike the traditional flat-plate solar panels familiar to most people attending today's hearing. This unique form factor expands the total addressable market for solar energy given that approximately three quarters of commercial and industrial rooftops in sunny environments are not designed to bear the load of rigid glass solar panels, which weigh about five times as much as SoloPower's panels. SoloPower's product can be integrated into a roofing membrane and unrolled on a rooftop much like carpeting. Alternatively, it can be adhered directly to a rooftop without the need for physical penetrations or racking systems. This speeds installation time and reduces balance-of-system ("BOS") cost, delivering an industry-leading levelized cost of energy that is competitive with retail electricity prices in many regions of the world.

Demand for SoloPower's product far exceeds its current manufacturing capacity, and the company has decided to build a large-scale manufacturing plant in the state of Oregon. The company selected Oregon because of the attractive incentives made available at the state and local level, including: low-interest loans, cash grants, and a state tax credit that can be converted into upfront cash through partnership with a local taxpayer. In addition, SoloPower received a conditional commitment from the U.S. Department of Energy for a $197 million loan guarantee. Without these incentives, SoloPower probably would have located its manufacturing operations outside of the United States.

<u>Historical Perspective: Development of Hybrid-Electric Vehicles</u>

The history of hybrid/electric vehicles tells a similar story. Thanks to the Toyota's Prius, most people assume that the hybrid electric vehicle was invented in Japan. In truth, the first full-sized hybrid vehicle was built in America in 1972. This first hybrid was not a Toyota, but rather a Buick Skylark which had been provided by General Motors and converted by an American engineer named Victor Wouk. The underlying technology behind the nickel-metal hydride ("NiMH") battery, one of the most important components of today's hybrids, was invented by Stanford Ovshinsky, an American and founder of the Ovonics Battery Company. General Motors acquired the NiMH battery patents from Ovonics and shut down GM's Electric Vehicles program before the battery could be commercialized. The patents ultimately ended up under the ownership of Chevron, which took no steps to deploy the technology in the U.S.

U.S. automakers would have been less likely to miss out on the opportunity of leading the world in hybrid vehicle technology if not for a stagnant government policy which failed to focus on an energy efficient future. In 1978, the Corporate Average Fuel Economy ("CAFE") standard for passenger vehicles was 18.0 miles per gallon. By 1990, it had increased to 27.5 miles per gallon. And for the next 20 years, until 2011, the CAFE standard remained at 27.5 miles per gallon. In the meantime, Japanese automakers were busy seizing the lead in hybrid vehicles using NiMH batteries as it sought to build vehicles for consumers seeking more fuel efficient vehicles. In 1997, Toyota unveiled the Prius, capitalizing on consumer interest in fuel efficiency. The rest is history.

With respect to the new generation of EVs, the batteries of choice are based on lithium ion technology. It should be no surprise that the underlying technology came from the U.S.: experimentation with lithium batteries begun in 1912 under G.N. Lewis, the dean of the chemistry department at University of California at Berkeley, and a research team led by an American chemist John B. Goodenough in the 1980s advanced the technology substantially and made commercialization possible. Today, Japanese manufacturers are the leaders in lithium-ion battery production, with South Korean and Chinese companies making significant inroads. U.S. battery companies, including A123 and Ener1, have excellent designs, but have outsourced their initial production overseas. However, with federal support now in place, Ener1 is building a plant in Indianapolis and A123 plans to build in Michigan. The lithium-ion battery market is projected to become a $40 billion market globally by 2020, so it is imperative that support continues for battery manufacturers.

California, the leading test ground for electric vehicles, passed its Zero Emission Vehicle ("ZEV") Mandate, which required two percent of the state's vehicles to have no emissions by 1998 and 10 percent by 2003. However, the law was repeatedly scaled back over the following decade to reduce the number of pure ZEVs it required.

Developing a New Approach that Provides Effective Support for the Clean Energy Industry

Over the last several years, Congress has explored enactment of a number of approaches for promoting clean energy. Such approaches have great merit for this industry. But in this era of severe budget constraints, I recognize the importance of finding an approach to clean energy support that imposes limited costs on the federal government.

Speaking from the industry's perspective, clean energy developers seek certainty and long-term support for their investments. As I have explained above, the reverse auction approach has had great success in other countries because it provides certainty to the industry. And it has great appeal to consumers because it drives down the cost of renewable power. I have been working with industry partners on a reverse auction approach that would (1) use a market-based approach to incentivize renewable development at the least cost; (2) would promote the development of a national REC market; (3) would transition the industry away from reliance on federal support; and (4) would not add to the federal budget deficit. I would be honored to appear before this Committee again at a later date to discuss reverse auctions and their potential role in U.S. energy policy in greater detail.

This Committee, and others in the Senate and House, will examine many specific pieces of legislation during this session of Congress. I have mentioned reverse auctions and financing incentives in my testimony today. Let me briefly discuss how they fit together. Depending upon the structure of a federally supported reverse auction program, further financing incentives offered by the United States might not be required to accomplish national clean energy policy goals for commercialized technologies. The devil is in the details. However, consideration of a federal reverse auction program must be coupled with assurance to the market that existing federal support mechanisms for clean energy will remain in place and will sunset as currently envisioned. With those ground rules in place, market participants will be encouraged and no unintended consequences will take place.

For technologies that are reaching the commercialization phase, risk capital will flow best from the private sector if federal support is focused on minimizing the cost of capital and improving access to liquidity through successful financing incentives such as the Loan Guarantee Program.

Conclusion

The U.S. has been the global leader in inventing the clean energy products that the world is currently using, and that leadership position, while threatened, has not yet been lost. However, without a national commitment to becoming a global manufacturing leader, and consuming those products at home to reinforce scaling of the market, the United States will not be able to retain its technology edge. With a bold renewed determination to reassert its leadership role in manufacturing and deploying critical technologies in the clean energy sector, the United States can retain its technology edge, create an abundance of high-value-added jobs, and afford Americans the opportunity to build a more prosperous economy.

I thank the Committee again for the opportunity and honor to present my views on this important topic of national interest.