WRITTEN TESTIMONY OF
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Chairman Lamborn, Ranking Member Holt and members of the Subcommittee:

Thank you for inviting the Center for Clean Energy Innovation (CCEI) to speak to the Committee this morning about the opportunities for energy innovation in the United States. From CCEI's perspective, clean energy provides two potential benefits:

(1) It's the fundamental technological solution to global climate change,
(2) It's an industry that can provide jobs and economic growth, namely through increased exports and decreased reliance on energy imports.

My testimony focuses on the second benefit, in particular the potential benefits of and barriers to the United States becoming a global leader in innovative clean energy technologies.

Clean Energy and Jobs

There is no doubt that the development and deployment of clean energy technologies creates jobs. In 2011, the Brookings Metropolitan Policy Program found that the "clean tech" segment of the economy, including renewable technologies (138,364), energy efficiency (830,146), and nuclear energy (74,749) totaled 1,043,259 jobs.[1] In comparison, during the same time period, the National Mining Association reports 89,838 total coal mining jobs and the Energy Information Administration reports 569,000 upstream jobs in oil and gas drilling, extraction, and support.[2]

The nature of clean energy job creation is different than fossil fuel job creation. Clean energy jobs, particularly those for wind and solar energy, are relatively more labor-intensive, requiring more manufacturing, construction, and installation jobs per unit of investment than fossil fuels. For example, the UC Berkeley Renewable and Appropriate Energy Laboratory (RAEL) found that over a ten year period the wind and solar industry create roughly 5.7 full-time jobs per year per million dollars of investment (otherwise defined as "person-years"). The coal industry creates roughly four, or 40 percent less than clean energy.[3]

Nonetheless, clean energy and fossil fuel jobs aren't mutually exclusive. Naturally, as clean energy market share increases, fossil fuel market share decreases over time. This will be particularly true if clean energy becomes capable of large-scale base load power production without the need for back-up power, which is largely provided by natural gas today. In a business-as-usual scenario and on a one-to-one job basis in the long-term, the overall growth in clean energy jobs in the United States will be modestly more than a similarly-sized fossil fuel-based economy.

Clean energy-based job growth could play a much more significant role in job creation if its market size expands beyond the United States. This can be achieved in two ways.

First, clean energy market share can increase if the country reduces energy imports. There's no better example of this than the recent impact of domestic natural gas fracking on energy imports. The natural gas fracking revolution has decreased U.S. reliance on petroleum imports from a high in 2005 of 60 percent to 35 percent by the start of 2014. Natural gas imports have fallen 34 percent during the same time period and show no signs of slowing.[4] According to IHS, the dramatic increase in domestic oil and gas production has created roughly 1.7 million temporary and permanent jobs throughout the drilling and production supply chain in 2013.[5]

Clean energy can have a similar effect on imports if alternative technologies become cost competitive with fossil fuels. Electric vehicles could eliminate the need for petroleum imports entirely, and a mix of energy efficiency and power producing clean technologies (e.g. wind, solar, and nuclear) could eliminate the need for natural gas heating, coal power, and natural gas power.

Second, clean energy market share can increase if it becomes a major domestic exporting industry. Compared to fossil fuels, clean energy is significantly more manufacturing-intensive. As a result, if the United States fosters a globally competitive clean energy industry that sells its products to the rest of the world, dramatically more clean energy job growth can be expected. For example, the Research and Policy Center of Environment California calculated that California-based solar and wind employment could be 16 times greater if it exported products than if it just produced for domestic consumption.[6]

The United States is falling behind its competition in this area. In 2012 China produced 64 percent of global solar modules compared to 11 percent from Europe and 3 percent from the United States.[7] There is strong global competition from China, Malaysia, India, Germany, and other countries for international leadership in clean energy exports, which is having a direct impact on jobs. From 2011 to 2012, U.S. solar manufacturing declined 38 percent, and the corresponding number of full-time equivalent solar industry jobs declined 20 percent, even as U.S. solar shipments increased 23 percent.[8]

Boosting Clean Energy Competitiveness through Innovation

While clean energy growth offers real and significant job benefits, these advantages are much less accessible in the United States without continued innovation to make clean energy technologies cheaper than their fossil fuel competitors. Energy is a fungible commodity. The electricity than comes from the electric socket is the same to the consumer whether it comes from a coal plant or a wind turbine. As a result, cost is the main differentiating characteristic among energy technologies.

The cost of clean energy has become much more competitive with fossil fuels in the last decade. The average price of solar PV has fallen 60 percent since 2011.[9] Average wind power purchase agreement prices have fallen 43 percent since 2009.[10] More modest cost declines have occurred for other clean energy technologies, including geothermal. Electric vehicles remain cost and performance limited compared to gasoline vehicles, largely due to limitations of existing battery technology, but costs are slowly falling.[11] Other clean energy technologies like fuel cells are just entering commercial markets for the first time. The cost of nuclear energy and carbon capture and sequestration remain high.

Certainly, these technology advancements are important and laudable. Nonetheless, the work is not finished—clean energy is not yet competitive with fossil fuels in the majority of energy markets in the United States and globally. The main competitor to clean energy is historically low natural gas prices, particularly outside of markets with significant solar and wind resources or generous clean energy tax subsidies. According to the U.S. Energy Information Administration (EIA), the levelized cost of new solar PV projects, which includes capital, operation, maintenance, fuel, and infrastructure costs, is 36 percent more expensive than conventional coal and 96 percent more expensive than conventional natural gas power plants before subsidies. New on-shore wind power projects are 16 percent cheaper than conventional coal and 21 percent more expensive than conventional natural gas. Figure 1 provides a useful summary of EIA's findings.[12]

Expanding clean energy competitiveness into more markets will take more technological innovation.[13] According to the International Energy Agency, "Promising renewable energy technologies (such as offshore wind and concentrating solar power) and capital-intensive technologies (such as carbon capture and integrated gasification combined cycle [IGCC]), have significant potential but still face technology and cost challenges, particularly in the demonstration phase." Potsdam Institute energy specialist Brigitte Knopf argues in a new study that substantial technological progress across a range of energy technologies, like third-gen solar cells, nuclear fusion, and others, is needed to meet long-term climate goals affordably. Next-generation nuclear energy (e.g., small modular reactors) requires materials innovation, advanced thermal reactor designs, supply-chain development, re-establishing a robust innovation and testing ecosystem, as well as new regulatory designs. And the U.S. National Renewable Energy Laboratory finds in a landmark study on transitioning to a renewable energy-only energy future, finds that significant innovation is needed to make energy storage, solar, wind, advanced geothermal, and biomass cost competitive.[14]

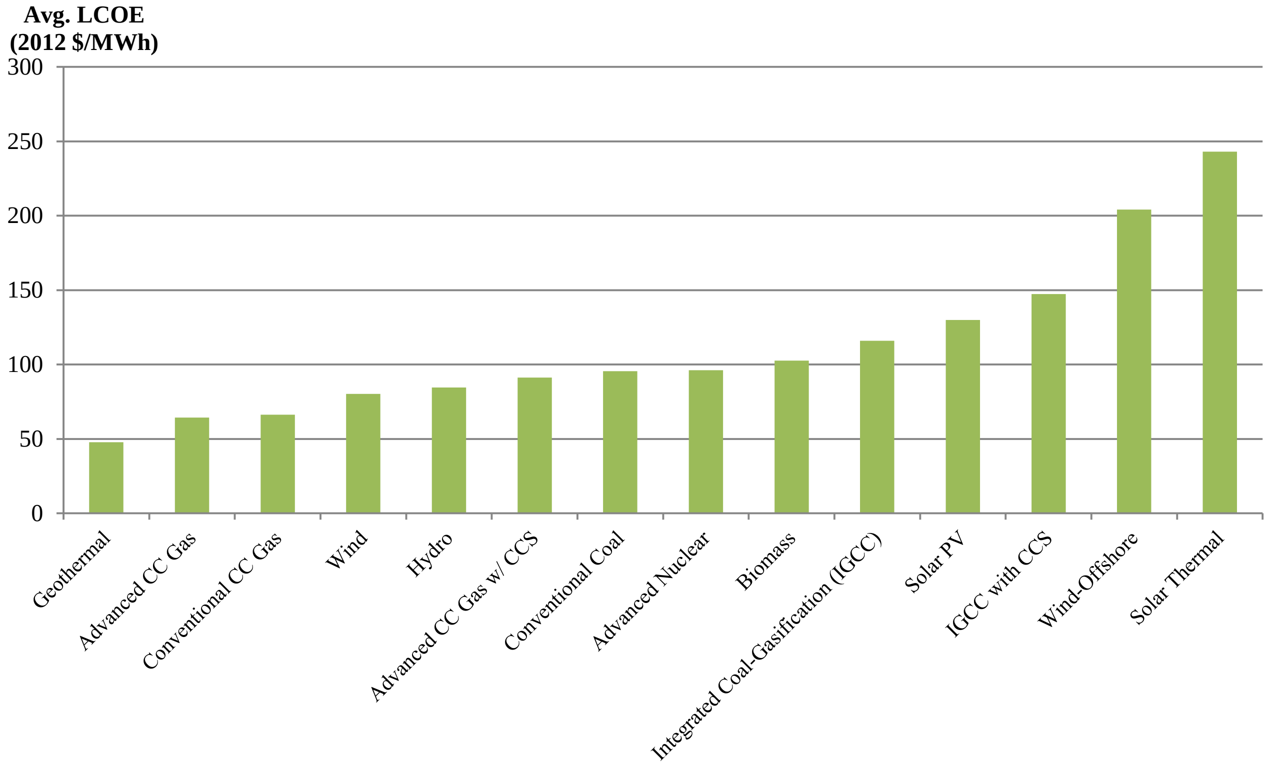

Figure 1: Average levelized cost of energy technologies entering service in 2019.

In particular, at least four major innovations are needed to make clean energy cost competitive with fossil fuels:

First, to balance intermittent renewables and power electric vehicles, low-cost, high-capacity batteries and energy storage technologies are needed. Simply put, without cheap energy storage, clean energy technologies won't be able to grow. Progress has been made in next-generation lithium-air and flywheel technologies, and more advanced chemistries are being worked on at our National Labs and universities. For example, electric vehicle battery costs have declined 67.5 percent since 2008.[15] And next-generation utility-scale zinc-air batteries are expected to enter the market at a competitive rate with natural gas back-up generation later this year.[16] Advanced storage chemistries and designs, including lithium-air, solid-state, and super capacitor batteries remain in the research and pilot phase.

Second, next-generation solar panels as cheap as coal and natural gas-based electricity would revolutionize the energy market. While distributed solar PV generation is significantly impacting niche markets, its expansion can be much greater if costs decrease and performance increases. This includes reducing the cost of solar without relying on mercantilist product dumping and unfairly subsidized manufacturing from countries like China and India, which flood the market, unfairly under-cut international competitors, and stifle clean energy innovation.[17] In absence of foreign subsidies and mercantilist policies, innovation that increases solar conversion efficiencies and lower installation costs are critical to making solar cheaper than fossil fuels.

Third, generation IV nuclear power technologies, including small modular designs, hold the potential for providing cheap, base-load low-carbon energy. While the United States is slowly moving towards building two generation III+ AP 1000 reactors, the true test of innovation and future nuclear cost competitiveness comes with the viability of generation IV technologies. The United States is currently advancing two designs (one by NuScale and another by Babcock & Wilcox) through technology development and regulatory hurdles. But other designs are languishing in development and other countries are moving much faster to both develop and license new technologies. Specifically, China is rapidly conducting research into molten salt-cooled reactors. At the U.S. Nuclear Regulatory Commission, sodium cooled fast reactors are slowly percolating through the pre-application process, while France, Japan, and South Korea have made it a core focus of energy commercialization strategies.[18]

Fourth, carbon capture and sequestration (CCS) would extend the life of existing coal and gas plants while dramatically reducing their carbon emissions. Unfortunately, costs remain high. The Energy Information Administration (Figure 1) finds integrated coal gasification plants with CCS are 54 percent more expensive than conventional coal plants and nearly 130 percent more expensive than natural gas plants. Adding CCS to advanced combined cycle natural gas plants increases costs by 42 percent, though natural gas with CCS is still 4 percent cheaper than conventional coal plants. To-date, the United States has invested modestly in CCS innovation. It made a one-time investment of $3.4 billion in CCS R&D (in addition to its modest annual appropriations) through the Recovery Act, which fueled additional demonstration projects. Even so, there are currently no commercial demonstration projects that successfully capture, transport, and sequester carbon, though there are a number of smaller-scale industrial pilot projects and other R&D efforts to bring down costs and improve performance.[19]

Of course, other clean energy innovations could lead a cost-driven transformation of the U.S. and global energy market, including advanced biofuels, fuel cells, offshore wind power, and concentrated solar technologies. The four focus areas of innovation are highlighted here because they represent those with the highest potential for extensive low-carbon transformation.

Making Clean Energy Cheap through Innovation Policy

Successfully achieving the above innovations—or any clean energy innovation—is not an easy task and it requires aggressive government innovation policy. The energy technologies we affordably benefit from today owe their existence to decades of U.S. innovation policy, including investments in research, development, demonstration, and early deployment. But the United States energy innovation ecosystem is only modestly supported, stagnant in places, and declining in others.

The perpetual uncertainty over annual energy RD&D budgets has been a significant barrier to innovation and has slowed progress in developing cheap, low-carbon energy alternatives to fossil fuels. Public investments in RD&D have hovered around $5 billion per year for the last five years, but experts suggest that number should be closer to $15 billion per year in order to achieve the breakthroughs in energy technologies necessary to bring alternatives to cost-competitive levels. While the FY2014 Omnibus Appropriations bill was able to halt sequestration cuts and offer modest increases to key energy innovation programs, these marginal improvements are not enough to establish an effective and thriving innovation ecosystem. The President's FY2015 budget does more to enhance budgets for the Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) and the Advanced Research Projects Agency – Energy (ARPA-E), which support advancing breakthrough grid and storage technologies, transformative transportation alternatives, critical manufacturing R&D processes, and other technologies. Unfortunately these proposed investments are still limited, and do little to establish a long-term clean energy innovation strategy for the United States.

Strengthening the energy innovation ecosystem is fundamental to spurring clean energy innovation, increasing U.S. clean energy competitiveness, and benefitting from more jobs and growth. Specifically, there are three steps Congress could take to increase the odds that America is the home to the clean energy revolution and the jobs that come with it.

First, increase funding for clean energy research, development, and demonstration (RD&D) through agencies like the National Science Foundation, Department of Defense and Department of Energy. The Recovery Act provided a useful jolt to the U.S. energy innovation ecosystem after decades of declining funding, but since those temporary investments ended, clean energy RD&D budgets have remained stagnant. Agencies such as ARPA-E operate each year vastly under its intended budget, and annual budget uncertainty is hampering America's brightest scientists and engineers from overcoming the barriers to cheaper clean energy. In an era of budget constraints one way to fund an increase in clean energy RD&D would be to increase the royalties on fossil fuel drilling on federal lands and/or eliminate subsidies for fossil fuels and devote these funds to a clean energy R&D trust fund. For example, CCEI has proposed modestly increasing fees on onshore and offshore oil and gas drilling to increase ARPA-E's budget to $1 billion per year.[20] More so, eliminating deployment subsidies for fossil fuels could allow Congress to double the investment in clean energy innovation—a historic long-term increase.

Second, Congress should use tax incentives for clean energy deployment to support emerging clean energy technologies instead of just propping up existing technologies. A number of innovation-based tax reforms proposals exist. A top example is the Energy Innovation Tax Credit, championed by Venture Capitalist Will Coleman, which would provide targeted, temporary incentives to energy technologies moving from lab to demonstration; once the technology hits commercial markets, the subsidy expires.[21] Another example is to make the R&D tax credit not only permanent, but accessible to start-ups and small companies. The American Research and Competitiveness Act of 2014 is an important bill that increases the generosity of the credit while making it permanent.[22] And Ranking Member Holt proposed a bill (H.R. 120) that would not only increase the generosity of the R&D tax credit, but also make it available to small businesses with little to no tax liability, an important provision so that innovative start-ups not yet making revenue can benefit from the credit.[23]

Third, Congress should take steps to reform our National lab system, which is weakly linked to industry, offering a broken pathway for new federally funded ideas to commercialize. CCEI, along with an unlikely bipartisan coalition of the Heritage Foundation and the Center for American Progress, proposed 12 reforms to the National Lab system to enhance its innovation capabilities.[24] The House could get a jump-start on these reforms by taking up the America INNOVATES Act, which currently benefits from bipartisan support in the Senate, and takes major steps to eliminate bureaucratic barriers to innovation at the Department of Energy (DOE) and National Labs. This includes eliminating signatory authority of the DOE for Lab-industry collaborations below $1 million, allowing the Labs to make targeted investment in technology maturation projects from its overhead accounts, and reforming the DOE management system to combine authorities over the Labs.

Conclusion

Two inherent truths about innovation are important to consider in this debate over clean energy and jobs: innovation is an uncertain process, and innovation does not magically occur by itself. No one can guarantee successful innovation, but we certainly know the mix of government policy, investment, and private-sector know-how that increased the probability and potential of innovations in the past. The same holds true for making clean energy cost competitive with fossil fuels. Innovation is what is driving the natural gas revolution and emergence of renewable energy technologies today, and it's what can propel clean energy moving forward.

Innovation also doesn't magically occur, particularly in the energy sector which historically invests less in innovation than any other industrialized sector in the U.S. economy. Rather it takes large, consistent, and targeted public investments in research, development, demonstration, and early deployment. It takes smart tax policies that demand innovation. It takes nimble, connected research institutions that can quickly hand-off new ideas and technologies to the private sector. It takes much more than the modest, but stagnant U.S. energy innovation ecosystem we have today.

In other words, if the United States wants to be a global leader in clean energy, export its products around the world, and create millions of new jobs, innovation policy is the most viable pathway to do so.

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