Statement of Dan W. Reicher
Executive Director
of the
Stanford University Steyer-Taylor Center for Energy Policy & Finance
and
Professor, Stanford Law School
Lecturer, Stanford Graduate School of Business
to the
House Committee on Science, Space and Technology
Subcommittee on Energy
and
Subcommittee on Oversight
Hearing on the Department of Energy Loan Guarantee Program
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Chairman Smith, Ranking Member Johnson, and members of the subcommittees, my name is Dan Reicher and I am pleased to share my perspective on the Department of Energy loan guarantee program, as authorized by Congress and administered by DOE's Loan Programs Office. I am Director of Stanford University's Steyer-Taylor Center for Energy Policy and Finance and a faculty member of the Stanford Law School and the Graduate School of Business. I am testifying in my individual capacity and my views do not necessarily reflect those of Stanford University.

I am also a senior fellow at the Brookings Institution, have been a member of the Secretary of Energy Advisory Board since 2013, and recently finished a 10-year term on the National Academy of Sciences Board on Energy and Environmental Systems. I also chair the board of directors of the American Council on Renewable Energy.

Prior to my role at Stanford, I was Director of Climate Change and Energy Initiatives at Google. I also served on President Obama's transition team where I helped develop the stimulus package for clean energy. Prior to my position with Google, I was President and Co-Founder of New Energy Capital, a private equity firm funded by the California State Teachers Retirement System and Vantage Point Venture Partners to invest in clean energy projects. Prior to this position, I was Executive Vice President of Northern Power Systems, a venture capital-backed renewable energy company.

Prior to my roles in the private sector, I served in the Clinton Administration as Assistant Secretary of Energy for Energy Efficiency and Renewable Energy, the Acting Assistant Secretary of Energy for Policy, and Department of Energy Chief of Staff.

Introduction

The Department of Energy's (DOE) Loan Programs Office (LPO) implements a key program, originally signed into law by President George W. Bush, that helps innovative U.S. energy and transportation technologies cross the colorfully but accurately named "valley of death" that sits between the early development of an advanced energy or vehicle technology and its full commercial deployment. By helping to cut the risk in technology commercialization, the LPO has increased U.S.

private sector investment in advanced energy and vehicle technology deployment, with the attendant economic, environmental and security benefits.

The loan guarantee program is at a pivotal point with the arrival of a new administration and questions in some quarters about the need for LPO investment. In sum, I believe the LPO is carrying out its Congressionally-directed mission very capably, both helping to commercialize important energy and transportation technologies and managing the related investment portfolio successfully. With more than $40 billion in remaining authority, the LPO is well positioned to advance important bipartisan U.S. priorities, particularly supporting a broad range of critically important energy and transportation-related infrastructure investments.

I. My Background in Energy Technology Commercialization

Let me briefly personalize the energy technology commercialization story, before I turn to a broader discussion of the federal government's role in commercialization and DOE's loan guarantee program in particular. For two decades I have walked the ups and downs of the energy research, development, demonstration and deployment (RDD&D) pathway. I started my journey at DOE under President Clinton where we invested substantially in advancing the full range of energy technologies. Energy-related R&D was – and is – a high-risk enterprise where the only certainty is that it almost always takes longer and costs more than originally anticipated to get an energy technology to a point where a private sector investor might invest and take things from there.

I left DOE at the end of the Clinton administration and joined a renewable energy company that had recently received significant venture capital investment. Our mandate was to take this high-risk capital and use it to turn the fruits of energy R&D into commercialized products that were successful enough that a bigger company would want to buy our firm or we could take it public. It was tough sledding at this company, in part because the route to successful commercialization of energy technologies is so challenging. One example: the company developed a more efficient and lower maintenance wind turbine but didn't have the cash it took to deploy enough of them – for a long enough time – to satisfy energy project lenders that they could back these turbines in utility-scale wind projects.

Proceeding down the RDD&D pathway, I helped form a private equity firm, with $100 million in capital we raised from a large public pension fund and a venture capital firm to invest in clean energy projects. We were the "equity" in these projects and we worked with banks and other "debt" providers - as well as engineering and construction firms - to get energy projects built and operating. It was at this firm that I reached perhaps the most challenging point along the energy RDD&D pathway.

Day after day our firm received investment proposals for energy projects based on technologies with profiles that simply exceeded the risk threshold of our capital. Had the underlying technologies been proven in a lab? Generally yes. Had they operated in a pilot plant? Sometimes. Had they operated at commercial scale for a long enough period of time that bankers would lend to projects that deployed them? Rarely.

We received so many project proposals – from wind, solar, biomass and geothermal, to advanced coal and natural gas projects, to nuclear power and beyond – but there were so few where we could actually make an investment. So what were we left with? Well, the truth is that the biggest chunk of

our capital, when I was at the firm, was used to finance corn ethanol plants – a technology well proven at large commercial scale for decades. We and most other private equity firms simply couldn't shoulder the risk inherent in the initial commercial scale-up of an energy technology, where a single project can costs hundreds of millions or even billions of dollars.

It was interesting landing next at Google, primarily a software company where engineers spend time – generally measured in months – writing computer code for a new software product, test it internally, and then one day determine it's ready for initial commercial deployment. In my simple terms, they push a button and it's deployed. If the product needs improvements then Google engineers make them and a new version is launched. There are certainly very tough engineering challenges and products that fail. It's just that with software my perception is that a product generally succeeds – or fails – faster and more cheaply than with energy technology. In the energy technology world, months turn into years, and years into decades, and billions can be spent on a single technology before even one commercial-scale plant is operating.

Following the 2008 election, I joined President Obama's transition team. I spent a significant time helping to develop the energy provisions of the stimulus package, eventually adopted by the Congress in the 2009 American Recovery and Reinvestment Act (ARRA). Among other things, the ARRA created a time-limited loan guarantee program to stimulate investment in shovel-ready energy projects during the depths of the financial crisis.

At Stanford I have continued to focus on the energy technology commercialization challenge, including in a course for graduate students in business, law and engineering on how to develop and finance energy projects.

II. The Importance of Federal Support for Energy Technology Commercialization

There is a view in our country today, mostly inside the D.C. beltway, that the federal government shouldn't play a role in commercializing energy technology. This view flies in the face of long-standing U.S. history – and basic business logic. The U.S. government has long played a vital and successful role in helping to commercialize energy technology and it is a role that should continue, especially in light of unprecedented competition from other countries, in particular China. Three examples follow.

a. *U.S. Commercial Nuclear Power*

The federal government, in the Eisenhower administration, financed the commercialization of civilian nuclear power, fully funding an Idaho reactor (EBR-I) "where usable electricity was first generated from nuclear energy in 1951". The federal government spent approximately $550 million in current dollars on the Idaho project.[1] Further government-funded civilian reactors followed, including six years later the federally-financed Shippingport reactor in Pennsylvania, "the world's first full-scale atomic electric power plant devoted exclusively to peacetime uses."[2] It was not until 1960 that we saw "the first U.S. nuclear power plant built without government funding."[3]

[1] http://www4vip.inl.gov/ebr/
[2] https://www.nrc.gov/about-nrc/emerg-preparedness/history.html
[3] Id.

The federal government has stayed in the nuclear power commercialization business helping to finance the scale-up of various technologies, some successful and some not. This includes federal funding of breeder reactors[4] and in recent years significant DOE investment in the development of small modular reactors, involving a number of U.S. companies.

Recently, the LPO backed the construction of the first new reactors in the U.S. in decades. The Vogtle project in Georgia is using the "next generation of nuclear reactors that incorporate a number of new safety features, including….passive safety systems that are able to respond in an emergency without any human intervention or electrical power."[5]

Recently, a bipartisan report to Secretary of Energy Moniz concluded that the successful development, commercialization and deployment of advanced reactor technologies in the U.S. at gigawatt-scale beginning in 2030 would require significant government investment, measured in the billions of dollars.[6]

b. Carbon Capture and Storage

The Department of Energy launched its program to develop and commercialize carbon capture and storage (CCS) technology in 1997. Over the past 20 years, it has relied on a variety of federal support mechanisms and incentives – R&D funding, grants, federal tax credits, private activity bonds and loan guarantees – to advance the technology. This array of federal support, measured in the billions of dollars, has helped advance first-time applications of CCS at a number of different types of U.S. facilities, for example a coal-fired power plant in Texas, an ethanol plant in Illinois, a Texas oil refinery and, most recently, a project that will help demonstrate CCS technology in natural gas-fired power generation.

Recently, the DOE LPO issued a conditional commitment for the first loan guarantee made under the Department's $8 billion Advanced Fossil Energy Project solicitation. The $2 billion loan guarantee would back the world's first methanol production facility to employ carbon capture technology, in Lake Charles, Louisiana. The captured carbon dioxide would be utilized for enhanced oil recovery (EOR) in Texas. The project would also be the first petroleum coke (petcoke)-to-methanol facility in the U.S.[7] Petcoke is a byproduct from oil refining. Methanol is one of the world's most widely used industrial chemicals in applications like paints, plastics, automotive parts and fuel blending.

c. Hydraulic Fracturing

The federal government played an important role in the commercialization of hydraulic fracturing ("fracking"), the process by which the U.S. has been able to access substantial deposits of shale gas, tight gas and tight oil. The private sector, particularly pioneers like George Mitchell, were instrumental in the development of fracking but the federal government supported commercialization of this important technology in a variety of ways. These include: shale fracturing and direct drilling technologies developed by the federal government and federal labs; public-private shale drilling demonstration projects in the 1970s; the section 29 production tax credit for unconventional gas in

[4] https://en.wikipedia.org/wiki/Clinch_River_Breeder_Reactor_Project
[5] https://www.energy.gov/articles/vogtle-big-results-nuclear-power
[6] https://www.energy.gov/sites/prod/files/2016/10/f33/9-22-16_SEAB%20Nuclear%20Power%20TF%20Report%20and%20transmittal.pdf
[7] https://energy.gov/articles/energy-department-offers-conditional-commitment-first-advanced-fossil-energy-loan-guarantee

effect from 1980 to 2002; federal funding of cost-shared fracking projects including Mitchell Energy's first horizontal well in 1991; and 3-D microseismic imaging developed by DOE Sandia National Lab. As a 2102 study concluded:

> *These federal investments, coordinated in close concert with gas industry representatives, were predicated upon a single mission: the commercialization of shale gas extraction technology. As a result of these efforts carried out over the course of 30 years, shale gas went from inaccessible deposits locked in unfamiliar geologic formations to the fastest growing contributor to the nation's energy portfolio.*[8]

d. The Business Case for Federal Support of Energy Technology Commercialization

These and many other examples point to the long-standing role the federal government has played – through Republican and Democratic administrations alike – in commercializing energy technology. As explained above, energy project developers and investors often can't or won't shoulder all the risk inherent in the initial commercial scale-up of an energy technology, where a project can costs hundreds of millions or even billions of dollars and there are a number of reasons the first-time project can fail.

The federal government, for decades, has been willing to step up, sometimes completely funding an initial commercial-scale project or cost-sharing it. From a business standpoint the government's role makes eminent sense. Back in the 1950s there was no way that an individual company or private investor was going to take the full risk of developing an early nuclear power plant. The technical unknowns and safety concerns were simply too great. Without the major investment the federal government made in the first generation of civilian reactors – measured in the billions of today's dollars plus the brainpower and facilities provided by federal labs – commercial nuclear power would not have developed at the pace and scale that it did, or perhaps would have been stillborn with an early accident.

Similarly, it is highly unlikely that utilities or energy companies would have shouldered the cost alone of the initial applications of CCS at U.S. power plants, refineries and other industrial facilities. While some of the underlying technologies, for example amine chemistry, had been used in other industries, the technical risks of a new application were too great for an individual company or utility to shoulder alone. This was particularly the case given current CCS economics in the U.S. – with no serious carbon pricing and a volatile market for the sale of CO2 (tied to the price of oil) for enhanced oil recovery. Securing a commercial loan for an initial scale-up plant in a setting like this was next to impossible.

And the partnership between the federal government and the natural gas industry was crucial in the efforts to develop hydraulic fracturing, a game-changing technology in the energy industry. George Mitchell, often called the "father of fracking", was a bold businessman but he enjoyed strong backing from the federal government in getting his important technology to commercial scale. It is conceivable he and others in the private sector could have succeeded without government help, but it is highly doubtful given modern fracking's dependence on government-born technologies like 3-D seismic imaging, along with generous government tax credits and early cost-shared projects.

[8] http://thebreakthrough.org/archive/shale_gas_fracking_history_and

The federal government backs energy technology commercialization efforts because they advance the economic, security, and environmental interests of our nation. Cutting our dependence on foreign energy sources, for example, partially drove the federal government's substantial support over decades in commercializing fracking. The future of fossil fuels in the U.S. and around the globe depends on cutting their environmental footprint and CCS has a major role to play. Adding to its benefits, the CO2 captured in some CCS projects finds a ready market in enhanced oil recovery, helping to squeeze out additional oil from older fields and leaving the CO2 back in the ground where it started. And the federal government may see some of the upside through royalty payments for oil on federal lands, while also increasing tax revenues to state and local federal coffers.

Outside of the energy context we don't generally have this debate about whether the federal government should back technology development and deployment. Thus the federal government, through DARPA, has had a major and well-supported hand in the development and application of revolutionary technologies ranging from the Internet and videoconferencing to GPS and the Cloud.[9]

e. China Is Poised to Dominate Clean Energy Globally

There is another reason why the federal government should continue its efforts in clean energy technology commercialization: the Chinese government and private sector have a well-organized and executed plan to dominate the energy technology industry, with all of its attendant economic, security and environmental benefits. From wind, solar and storage to nuclear power, advanced vehicles, steam turbines and transmission, China is not only dominating in low-cost manufacturing and domestic deployment but increasingly in energy technology R&D and commercialization, traditionally the U.S. strong suit. My Stanford center is finishing up a major report on the Chinese solar industry, funded by DOE, and it has been eye opening to understand how far the Chinese have come in solar R&D, including recently posting an important world record in solar cell efficiency. The Chinese government and industry have a well-organized partnership to dominate the solar industry, and several other energy technologies as well.

In the next twenty years, the International Energy Agency projects that the world will spend roughly 48 trillion dollars on energy, one of the biggest economic opportunities of the 21st century. China is getting organized to grab the biggest piece of this economic pie. We ignore China's resolve – and impressive success to date – at our peril. And it is this situation that makes the attacks on federal energy technology commercialization, like the DOE loan guarantee program, so misguided and troubling.

f. Should the Government Pick Winners and Losers?

In the debate over the DOE loan guarantee program there is also this argument: "the government shouldn't be picking winners and losers." The DOE loan guarantee program, as designed by Congress, has a broad technology focus with specific funding allocations across an array of technologies, including nuclear, fossil, renewables and efficiency. This ensures that no particular technology is favored. While much of the early LPO investment was in renewables, the current remaining Title XVII authorization is largely for nuclear and fossil projects. Furthermore, by far the largest loan guarantee to date has been for the Vogtle nuclear reactors and the most recent LPO

[9] http://www.alphr.com/features/373546/10-brilliant-darpa-inventions/page/0/1

conditional guarantee is for the Lake Charles petroleum coke CCS project. And it should be noted that the LPO is an application-based process: companies must apply for a loan guarantee, meet a number of explicit and well-established eligibility criteria, and pay significant fees, in order to secure a loan or loan guarantee.

More broadly, this argument against picking winners and losers collides head long with reality. The federal government picks winners and losers all the time and in fact the Congress, through the 1984 Competition in Contracting Act[10], has generally insisted on competition in discretionary federal funding programs. Thus, as Boeing and Lockheed-Martin know well, the Pentagon has required competition in the procurement of the military's next jet fighter. The General Services Administration generally does the same for a range of products and services supporting the work of government agencies. And it should come as no surprise that DOE generally insists on competition - and often private sector cost share - for much of its energy technology funding, including recent support for small modular reactors, CCS and off-shore wind.

III. The Case for Federal Loan Guarantees

President George W. Bush signed legislation launching the two key DOE loan programs under discussion today. Title XVII of the 2005 Energy Policy Act, enacted by a Republican-led Congress, directed DOE to issue loan guarantees to support the commercial deployment of energy projects that "employ new or significantly improved technologies as compared to commercial technologies in service in the United States at the time the guarantee is issued" and cut greenhouse gas emissions. The Title XVII program covers a number of eligible technologies including advanced fossil, nuclear, and renewable energy, and energy efficiency.

Congress authorized the Advanced Technology Vehicles Manufacturing (ATVM) program under Section 136 of the Energy Independence and Security Act of 2007. It authorizes the DOE to issue direct loans to auto manufacturers and component suppliers for manufacturing of advanced technology vehicles and associated components in the U.S.

President Obama signed a third bill in 2009, the American Recovery and Reinvestment Act (the "stimulus bill"), that authorized a new deployment-oriented loan guarantee program to stimulate job creation during the financial crisis and also appropriated funds to cover "credit subsidy" costs for borrowers. This program, which funded a number of LPO loan guarantees for "shovel-ready" energy projects, expired in 2011. The Congress the same year also appropriated funds to cover credit subsidy costs for the ATVM program and in 2011 did the same for energy efficiency and renewable energy projects under Title XVII.

The two current loan guarantee programs – Title XVII and ATVM – enjoyed Republican and Democratic support for a reason: they are a smart way to leverage private capital in advancing the commercialization of an innovative energy technology or increasing domestic manufacturing of fuel-efficient vehicles. In simple terms, the programs support energy and transportation technologies that are ready for commercialization but face challenges raising capital in the debt markets.

[10] https://fas.org/sgp/crs/misc/R40516.pdf

In contrast with federal grants, which constitute one-time "money out the door" expenditures, loans and loan guarantees are the federal financial mechanism "that keeps on giving". Thus the innovative U.S. auto manufacturer Tesla Motors received a $465 million ATVM loan at a critical moment in its efforts to buy a shuttered former GM-Toyota manufacturing plant in California. The loan was pivotal in Tesla's efforts to reopen the factory, creating more than 3000 full-time jobs in the process. And critical to today's hearing, in May 2013 Tesla repaid the federal government the entire remaining balance on its loan – nine years early and with interest.

To this end, LPO loans and loan guarantees are structured to be fully repaid with interest over the life of the loan. Each project in the portfolio must begin repaying the principal and interest on its loan around the time it reaches completion. As many of LPO's projects have reached completion in recent years, project sponsors have been repaying their loans. **As of December 31, 2016, LPO borrowers repaid $6.65 billion in principal and $1.79 billion in interest.** So not only is an LPO loan repaid but the federal treasury – aka U.S. taxpayers – see the upside in the form of major interest payments

a. The LPO's Strong Financial Track Record

Beyond the debate over the philosophy underlying the Title XVII and ATVM programs, critics of the programs have raised issues regarding LPO's financial management and track record. There has been a great deal of hand-waving on this subject, particularly focused on a few failures in the LPO portfolio, chief among them the Solyndra loan guarantee. What all of the noise about Solyndra obscures is LPOs admirable track record in commercializing energy technology and increasing U.S. production of advanced technology fuel-efficient vehicles with thousands of related jobs.

The best way to take stock of LPOs financial management is to do what any portfolio manager would do: scrutinize portfolio results to date and the status of individual investments. A quick review should give members of the committee, and U.S. taxpayers more generally, confidence about the LPO track record.

As of December 31, 2016 22 projects supported by LPO are operational and generating revenue. These projects are now repaying their loans to the U.S. Treasury, which issued the loans guaranteed by the DOE primarily through the Federal Financing Bank. Already, as noted above, $6.65 billion in loan principal has been repaid on these long-term loans, which have an average tenor of 22 years. Importantly, the U.S. Treasury has received more than $1.79 billion in interest payments. For loans that have been disbursed to date, more than $5 billion in total interest payments are expected over the full term of the loans - to the benefit of taxpayers.

However, losses are also anticipated in any lending portfolio. And because the mission of LPO is to finance innovative technologies that have not been deployed at commercial scale in the U.S., the program was designed to carry some level of risk. In light of this Congress set aside funds to cover those losses when the program was established. **But today, actual and estimated loan losses to the portfolio are approximately $810 million, or only a little over 2 percent of the program's loans, loan guarantees and commitments - and roughly half of the approximately $1.79 billion in interest payments the program has earned to date. Importantly, this $810 million in loan losses is a small fraction of the $10 billion set aside by Congress to cover failed loans.**

As projects continue to repay loans and as LPO issues new loans and loan guarantees with its more than $40 billion in remaining authority, these portfolio numbers will continue to change. But given

the strong portfolio management by the highly experienced team of LPO professionals, DOE expects the portfolio's financial performance to remain strong and continue to advance the commercialization and deployment of key energy and transportation technologies.

In the last ten years, the Government Accountability Office (GAO) has published eight reports reviewing the loan guarantee program and providing recommendations to DOE. Of the 24 recommendations GAO has made concerning the program, the DOE has fully implemented 15. The LPO is actively working towards fully implementing three more, has partially implemented one, and has concurred with GAO's findings for two more. Of the 24, LPO has only disagreed with and declined to work towards implementing 4 of the recommendations. It should also be noted that GAO has made no additional recommendations in either its 2015 or 2016 report.

b. A Few Losses Shouldn't Obscure The Overall Success of the LPO

Despite the overall success of the LPO portfolio there has been much focus on a handful of losses. Most well-known among them is Solyndra, which was indeed a major loss in the LPO portfolio but it has been used for years to impugn the overall program more broadly. This is unfortunate because as described above the full portfolio is in admirable shape. **A key fact: LPO has about a 2% loss ratio, less than the loss ratio in the loan portfolios of just about every U.S. money center bank, and these banks are generally not making loans for energy projects deploying advanced technologies – and certainly not in the riskier commercialization stage.**

It should also be noted that most of the loans and loan guarantees in the Title XVII LPO portfolio have been for energy projects secured by a long-term power purchase agreement from a major utility or corporation or similar commitment. The rationale for a DOE loan guarantee in these cases is that (a) the borrower, generally an energy project developer, is credit worthy because of the long-term off-take agreement but (b) there are technical or scale-up risks in the underlying technology that lenders will not take. In contrast, Solyndra involved a loan for a solar manufacturing plant selling products into a commodity solar panel market without the benefit of a long-term sales contract. This was a riskier bet in a broader portfolio that is mostly built around projects with long-term off-take commitments and therefore a safer risk profile.

c. DOE Has Addressed the Credit Subsidy Issue

There have been issues under Title XVII whether DOE has been adequately charging for the cost of the liability that government takes on in issuing a loan guarantee. To this end, Title XVII specifies that the DOE must receive either a federal appropriation for the Credit Subsidy Cost (CSC) – the expected long-term liability to the Federal Government in issuing the loan guarantee – or payment of that cost by the borrower. Under the current Title XVII program borrowers pay the CSC directly. Additionally, LPO determined that a credit-based interest rate spread will be added to certain loans that are issued by the Federal Financing Bank (FFB) and backed by a 100 percent loan guarantee issued by the DOE. In simple terms the lower the credit score of a particular project the higher the interest rate spread.

Further strengthening the government 's coverage of its liability, just last month DOE adopted a final rule imposing a "Risk-Based Charge" taking into account all interest and interest-related costs. The rule is intended to make DOE's charges and costs consistent with commercial markets and other federal credit programs. This Risk-Based Charge will be used only to the extent the aggregate of

other interest-related charges do not sufficiently reflect creditworthiness or specific risks arising from individual transactions.

With this recent rule change DOE appears to have addressed concerns about adequately covering the federal government's long-term liability for particular projects.

IV. A Strong Future for the Federal Loan Guarantee Program

The DOE loan guarantee program rests on a solid base: a strong need for its services and an admirable track record to date in providing them. In setting a path forward for the program there are several considerations:

a. There is Substantial Remaining Funding Authority

While the LPO has used about half of its loan and loan guarantee authority provided by Congress, there is $41.5 billion in remaining authority. This includes $16 billion in the ATVM program and $25.5 billion in the Title XVII program, with $12.5 billion for advanced nuclear projects, $8.5 billion for advanced fossil projects and $4.5 billion for renewable energy and energy efficiency projects (the relative small allocation for renewables and efficiency reflects greater LPO investment in these technologies in initial phases of the program). Importantly, there is also strong interest among applicants for additional support. **DOE reported in December that LPO has received more than 70 applications in response to its current solicitations for almost $50 billion in loans and loan guarantees.**[11]

b. Some Needs Have Already Been Addressed – LPO Success in Utility-Scale Solar

Some technology areas have been addressed and are unlikely to need additional LPO support. For example, prior to 2010, there were no utility-scale PV projects in the United States greater than 100 megawatts. LPO helped finance the first five utility-scale PV projects, and since then the private debt markets have taken over, financing many more projects.[12] There are now 48 other privately financed U.S. PV projects greater than 100 megawatts operating as of January 2017. Another 83 planned solar PV farms greater than 100 megawatts have been announced, representing over 20 gigawatts of new utility-scale capacity.

In addition to solar PV, Title XVII also supported a number of projects involving Concentrating Solar Power (CSP).[13] U.S. leadership on these technologies has placed the developers of these Title XVII-supported projects at the forefront of the global CSP market. The developer of the Crescent Dunes project, California-based SolarReserve is now exporting the CSP technology used at the project to other global markets – including Chile and South Africa, where SolarReserve has been approved for a 100 MW plant. BrightSource, the original developer of the Ivanpah CSP project, is also expanding its work to other nations. The company's solar field technology is being deployed at the world's tallest CSP tower now under construction in Israel. BrightSource also formed a joint venture with Shanghai Electric Group to sell its technology in China, and the JV's first project was one of 20 chosen from 109 applications under China's 1.35 gigawatt CSP Pilot Program.

[11] https://energy.gov/articles/energy-department-offers-conditional-commitment-first-advanced-fossil-energy-loan-guarantee
[12] https://www.energy.gov/lpo/articles/mesquite-solar-highlights-how-doe-loan-guarantees-helped-launch-utility-scale-pv-solar
[13] https://energy.gov/lpo/articles/celebrating-potential-energy-storage-technology

c. There Are Several Emerging Areas of Need For LPO Support – Infrastructure In Particular

Infrastructure has emerged as an area of both substantial national need and bipartisan support. There are several areas where the DOE loan guarantee program could provide much needed investment in U.S. infrastructure and simultaneously support important technology innovation. Several examples follow.

- *Electricity Transmission Projects*: To date the LPO has provided support for one U.S. transmission project deploying advanced technology. DOE provided a $343 million Title XVII loan guarantee for the One Nevada Line that uses tubular guyed-V transmission towers with a much smaller footprint and easier and more cost-effective construction.[14] The LPO could do more to support much needed transmission development and the commercialization of advanced transmission technologies. New transmission is needed across the nation to upgrade current capacity and add new lines to move renewable generation from resource-rich areas to distant load centers. When he was governor, DOE Secretary-designee Perry oversaw the nation's most successful development of new transmission capacity that helped Texas become the top wind energy producing state in the nation.
- *Electricity Storage Projects:* LPO has provided one Title XVII loan guarantee for an electricity storage project – the Stephentown Spindle – a flywheel storage project in New York State.[15] Electricity storage, especially long-duration utility-scale systems, is critically needed in our electrical system and there are an array of technologies that could benefit from commercialization support, including thermal systems, compressed air, advanced pump storage, and new battery technologies.
- *Carbon Capture and Storage:* As described above, LPO has provided one loan guarantee for a CCS project – a $2B Title XVII guarantee for the Lake Charles Methanol project, the world's first methanol production facility to employ CCS technology.[16] The captured carbon would be used for enhanced oil recovery (EOR) in Texas. This project is the first loan guarantee made under LPO's $8 billion Advanced Fossil Energy Project solicitation. LPO has significant remaining authority to advance other CCS projects deploying advanced technologies. There are an array of proposed projects that could commercialize CCS in both power and industrial applications. One of those is the use of CCS in natural gas-fired power plants. Exelon and Net Power are demonstrating one approach[17] and DOE has recently funded another demonstration project[18] but full-scale projects will be necessary to establish the commercial viability of the approach and support mainstream project finance. There may also be opportunities to support CO2 pipeline infrastructure related to a CCS project.
- *Advanced Nuclear Technology:* LPO has provided one loan guarantee for a nuclear power plant – the Vogtle project in Georgia, as discussed above. There are an array of new nuclear technologies that could benefit from additional LPO support. To that end, in September 2016, DOE invited Terrestrial Energy Inc. to submit the second part of its application for a loan guarantee for an integrated molten salt reactor.[19] And earlier DOE provided a conditional $2B loan guarantee for a

[14] https://energy.gov/lpo/one-nevada-line
[15] https://energy.gov/lpo/stephentown-spindle
[16] https://energy.gov/articles/energy-department-offers-conditional-commitment-first-advanced-fossil-energy-loan-guarantee
[17] https://www.snl.com/interactiveX/Article.aspx?cdid=A-31571952-12589
[18] http://www.utilitydive.com/news/doe-awards-80m-for-first-large-scale-supercritical-co2-pilot-plant/428552/
[19] http://www.forbes.com/sites/rodadams/2016/09/14/terrestrial-energys-advanced-nuclear-technology-the-imsr-takes-several-steps-forward/#6927c049733e

uranium enrichment plant in Idaho.[20] LPO has significant remaining authority to advance other nuclear projects deploying advanced technologies. Principal among them could be the first U.S. small modular reactor project.

- *Vehicle Charging and Fueling Infrastructure:* LPO recently announced that Title XVII loan guarantees could support the development of electric vehicle charging facilities as well as vehicle refueling infrastructure using hydrogen, liquefied natural gas (LNG), compressed natural gas (CNG), and biofuels. [21]
- *Advanced Transportation Vehicle Manufacturing:* LPO has substantial remaining financing authority under the ATVM program. ATVM loans may be used to finance the cost of reequipping, expanding or establishing manufacturing facilities in the U.S. to produce advanced technology vehicles or qualifying components. They can also be used for engineering integration in the U.S. of advanced vehicles or qualifying components. To date LPO has provided financing for advanced vehicle projects focused on upgrading facilities to produce more fuel-efficient engines (e.g. for the Ford F-150 truck), new battery production capacity, all-electric vehicle assembly, and powertrain and electric motor production. These kinds of investments, plus other technologies like "light-weighting" of auto components, could be helpful as our nation seeks to slow the loss of its domestic auto and auto parts manufacturing capacity to other countries and also stimulate growth in the competitive electric vehicle manufacturing business, where China is increasingly leading the world.

V. Next Steps

The new administration, in particular the new Secretary of Energy, will need to focus on next steps for the loan guarantee program, building on the successful work currently underway at LPO. The likely trajectory is to allocate the remaining funding to a set of projects reflecting the remaining balances, which are largely focused on advanced nuclear, fossil and transportation projects. Along the way, Congress, working with the president, might authorize additional LPO loan authority to advance critical energy and transportation technologies vital to both U.S. competitiveness and environmental goals. President Obama proposed this approach in his FY2017 budget, including another $4 billion in new loan authority for advanced fossil, renewable energy and energy efficiency projects.

Another option would be to transition existing loan authority from the LPO to an independent federal revolving fund. The LPO already has a successful program structure in place, including the needed staff and resources, to manage such a fund. This might be part of a larger independent federal entity with a broader set of tools, such as the Clean Energy Deployment Administration (CEDA), introduced in bipartisan legislation by then Senate Energy Committee Chair Jeff Bingaman (D-NM), with support from current committee chair Senator Lisa Murkowski (R-AK)

CEDA would administer various types of credit instruments, such as loan guarantees, insurance products, and clean energy backed-bonds to accelerate private sector investment in the commercial deployment of new energy technologies. Initially funded with an appropriation of $10 billion, CEDA could become a self-sustaining entity based on "profit participation" mechanisms that would allow it take a financial stake in the projects it backs. This "evergreen" approach would distinguish it from

[20] https://energy.gov/lpo/areva
[21] https://www.energy.gov/lpo/electric-vehicles-and-alternative-fuel-vehicles

the current LPO that cannot recycle repayment of loan principal and interest into new investments. Also, while CEDA would be established as an agency within DOE it would be under the direction of an administrator, a board of directors, and technical advisory council and would enjoy a degree of independence from what may be perceived as an administration's influence on its investment decisions.

Conclusion

The DOE loan guarantee program has a strong track record and a bright future, particularly helping to advance the current bipartisan interest in increasing investment in energy and transportation-related infrastructure. With more than $40 billion in remaining authority, the loan guarantee program, as administered by the highly professional DOE loan programs office, could do much to help commercialize advanced U.S. energy and transportation technologies in support of our nation's economy, environment and security.