ENERGY FUTURES INITIATIVE

Leveraging the DOE Loan Programs

Using $39 Billion in Existing Authority to Help Modernize the Nation's Energy Infrastructures

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Executive Summary

There is a currently a great deal of interest in modernizing the Nation's infrastructures – a suite of actions and investments that are essential for the economic growth, security, health and well-being over the long run, but expensive in the near-term. How the Congress chooses to fund the federal portion of an infrastructure plan is uncertain, especially in view of the significant deficits and increased national debt expected over the next several years.

One available tool to help address both infrastructure modernization needs, as well as deficit concerns, is the Department of Energy's Loan Programs. *These programs currently have $39 billion in available loan and loan guarantee authority that could be used, all or in part, to finance innovative energy infrastructure projects without the need for any new appropriations.*

DOE's loan programs could also play a central role in the broader effort to modernize the Nation's infrastructure as envisioned in the framework the Administration sent to Congress in early February. The Department of Homeland Security describes the Energy Sector as "uniquely critical because it provides *an enabling function across all critical infrastructure sectors*...the reliance of virtually all industries on electric power and fuels means that all sectors have some dependence on the Energy Sector."

The DOE Loan Program Office (LPO), initially authorized and signed into law in 2005 by President Bush, manages a $30 billion portfolio and provides a credit backstop that has been used to leverage $50 billion in investments in commercial projects that deploy innovative energy technologies. The LPO portfolio has a default rate of just over two percent, a record that compares favorably to private lending institutions even though its principal objective and success lies with first-time, commercial scale deployments of innovative energy technologies. Important examples of its successes include providing the impetus for utility scale solar energy and re-tooling and reviving advanced auto manufacturing plants in eight states from Tennessee and Kentucky to the upper Midwest to California.

Assuming a similar track record of success going forward, the LPO's estimated $39 billion remaining loan and loan guarantee authority could leverage as much as $100 billion of investments in innovative approaches to modernizing energy infrastructures across all energy sectors. Increased leveraging could be achieved through a combination of co-lending by the private sector, states and other federal credit programs as well as increased equity participation. In addition, the availability of federal loan guarantees could send an important signal to private firms contemplating increased capital investments in modernizing energy infrastructures and could help offset the less favorable provisions affecting debt financing contained in the Tax Cut and Jobs Act of 2017.

The DOE loans programs could also provide a complementary vehicle for supporting the Administration's proposed *Transformative Projects Program* (TPP), described as grants for "...bold, innovative and transformative infrastructure projects that could dramatically improve infrastructure." As a grant program, the TPP would require funding outlays that could increase the deficit; pairing the objectives of the TPP with the existing authorities of the LPO could significantly reduce the costs of the TPP. Types of innovative TPP energy infrastructure projects that could be both "transformative" and eligible for support from the LPO could include: energy management solutions for urban transportation systems; application of platform technologies such as digitization, big data analytics or artificial intelligence to support energy efficient smart cities; credit support for bundling of distributed electricity generation and storage projects, including in rural and tribal areas; and cybersecurity enhancements for grid protection.

This report provides an overview of the important role LPO has played in advancing energy innovation in America and how, going forward, the program can be used to finance the next generation of major energy infrastructure projects in the United States. The report examines a range of issues, including: current energy infrastructure investment needs; ways to deploy LPO's existing loan authority; trends that underscore the need for innovative investments in energy infrastructure; ways both programs could be used for funding critical energy- and transportation-related infrastructure needs; and recommendations for process improvements. It also provides an overview of the Tribal Energy Loan Guarantee Program, for which LPO manages the credit underwriting. The benefits described in this report can be realized with minor changes in current eligibility requirements and, as noted, with *no new appropriations*.

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Leveraging DOE's Loan Programs: Using $39 Billion in Existing Authority to Help Modernize U.S. Energy Infrastructure

U.S. infrastructure and the need for its maintenance and modernization is currently generating a good deal of news and political interest. The President highlighted infrastructure in his State of the Union and has submitted an infrastructure modernization framework to Congress. Further, infrastructure improvements are generally viewed as having significant bipartisan appeal in a time when partisanship appears to guide many of the actions and reactions to federal policy.

Infrastructure modernization and upgrades are essential for the Nation's economy, security, health and well-being over the long run, but are expensive in the near-term. How the Congress chooses to fund the federal portion of an infrastructure plan is uncertain, especially in view of the significant deficits and increased national debt expected over the next several years.

This paper discusses an available option to help answer the question on how to finance a portion of these critical improvements: the Department of Energy's Loan Programs run by the Loan Program Office (LPO) that have a history of investment successes, as well as existing and significant available capacity for a set of actions to help modernize and transform the Nation's infrastructure.

While it has been attacked in the past, the LPO's record of a two percent default rate and early loan repayments, e.g., a $465 million loan to reopen a shuttered automotive manufacturing plant in California paid off nine years before required, is as good or better than many private lending institutions. The $30 billion credit backstop provided by LPO has also leveraged a total of $50 billion in projects. Estimates suggest that using the $39 billion in currently available loan and loan guarantee authority, DOE's loan programs could leverage up to $100 billion of investments to support innovation and infrastructure investment across the entire energy sector.

Estimates suggest that using the $39 billion in currently available authority, DOE's loan programs could leverage up to $100 billion of investments to support innovation and infrastructure modernization across the entire energy sector.

This option is attractive for many reasons. Modernized energy infrastructure is an essential element of critical infrastructure. The Department of Homeland Security describes the Energy Sector as "…uniquely critical because it provides an enabling function across all critical infrastructure sectors…supplying fuels to the transportation industry, electricity to households and businesses, and other sources of energy that are integral to growth and production across the nation…The reliance of virtually all industries on electric power and fuels means that all sectors have some dependence on the Energy Sector." [1]

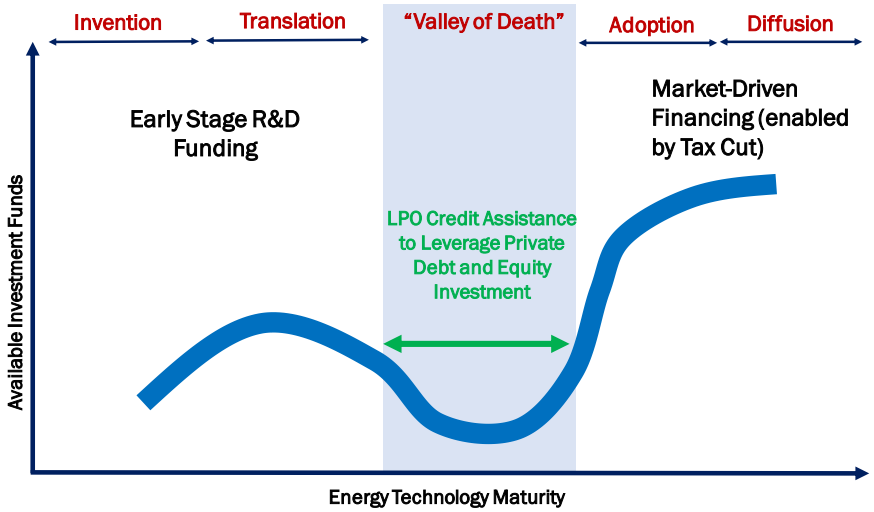
The LPO credit assistance programs -- the Title XVII loan guarantee program for innovative technologies and the Advanced Technology Vehicle Manufacturing loan program – can be readily adapted to provide credit support for a broader range of innovative energy infrastructure investments. Re-positioning the LPO programs can accelerate the process of

integrating innovative technologies and systems solutions as part of a modernized energy infrastructure.

Given their mission, capacity and capability, DOE's loan programs also provide ideal vehicles for supporting the Administration's proposed *Transformative Projects Program* (TPP) described in its infrastructure modernization framework, as grants for "…bold, innovative and transformative infrastructure projects that could dramatically improve infrastructure." This combination could make U.S. energy systems more resilient, make the Nation's cities smarter, safer and cleaner, and help rural and isolated communities grow their economies. Also, because the remaining loan programs authority is large – close to $40 billion – and can leverage tens of billions more in private sector funds, a creative combination of the TPP and Loan Programs could have transformative impacts at much lower cost than the grant program envisioned in the TPP proposal.

Types of innovative energy infrastructure projects that could be both "transformative" and eligible for support from the LPO: energy management solutions for urban transportation systems; application of platform technologies like digitization, big data analytics or artificial intelligence to support smart cities; credit support for bundling of distributed electricity generation projects in rural areas; and cybersecurity for grid protection.

Figure 1. LPO Bridges the Financing Gap in the Technology Innovation Process



Moving from R&D, to demonstration to deployment to diffusion requires the alignment of many players, processes and programs. The LPO provides critical "de-risking" to initial commercial deployment.

With or without a creative TPP combination and without any additional funding, the current loan programs could provide several key links in the clean energy infrastructure innovation chain. First and foremost, they provide a critical bridge over the "Valley of Death" between translation and adoption of new technologies (Figure 1). Also, initial deployment of innovative technologies with LPO credit support sets the stage for further market diffusion of the technologies and provides multiple feedbacks that spur future innovations.

Finally, the LPO can provide a bridge between critical energy infrastructure modernization and continued U.S. leadership in global technology innovation. DOE's loan programs could help enhance the Nation's global competitiveness relative to other countries. China, for example, is pouring hundreds of billions of dollars into a modern, innovative electricity infrastructure to support its explosive economic growth and rapidly-expanding global footprint. The United States needs a corresponding and equivalent focus.

U.S. economic competitiveness, security, a modern energy infrastructure and a robust innovation ecosystem go hand in hand. The Loan Programs at DOE provide important linkages between all of these key enablers of national success. More specifically, the LPO provides the perfect vehicle for supporting the "Transformative Projects Program" in the Administration's recently released infrastructure modernization framework, described as providing Federal support for "...bold, innovative and transformative infrastructure projects that could dramatically improve infrastructure."

Overview of the DOE Loan Programs

The LPO issues loan guarantees through the Title XVII program, designed to accelerate the deployment of innovative clean energy technologies, and direct loans through the Advanced Technology Vehicles Manufacturing (AVTM) program, for retooling domestic auto component manufacturing and to produce advanced technology light-duty vehicles. The LPO also supports the DOE Office of Indian Energy Policy and Programs authority to issue loan guarantees for energy development projects on Tribal lands (Figure 2).

Technology innovations move into the marketplace through a process of invention, translation, adoption and diffusion. This process requires collaboration among numerous players and can be highly non-linear, often involving a series of feedbacks initiated from learning by doing and using, which promotes continuous improvement from invention to diffusion (Figure 3).

The LPO has played an important role in this innovation process and market by bridging the gap for commercial lenders, who are often unwilling or unable to take on the risk of a new technology until it has a solid

Figure 2. Structure of the DOE Loan Programs

Title XVII Loan Guarantee Program. This program validates the creditworthiness of projects to provide confidence to both equity investors and lenders who might otherwise be unable or unwilling to finance early commercial deployment of innovative technologies.

Unlike federal direct-funded or cost-shared projects, capital expenditures for a project backed by a federal loan guarantee are not scored as direct outlays in the federal budget. Instead, the budgetary cost of a loan guarantee is measured as the net present value of the expected cost to the government over the life of the guaranteed debt, accounting for the schedule of loan disbursements and repayments, the possibility of default and the prospects for recoveries in the event of default. The cost of the loan guarantee is paid either through a fee paid by the project sponsor (the so-called self-pay loan guarantee) or through an appropriation (a credit subsidy appropriation).

The DOE Title XVII loan guarantee program is primarily a self-pay program, but also operates with a limited amount of appropriated credit subsidy for renewable energy and energy efficiency projects. Projects with DOE loan guarantees can source the loan either in the private sector or through the Federal Financing Bank (FFB), an arm of the Treasury Department. As a matter of policy, the Treasury Department encourages projects with federal loan guarantees to be financed through the FFB to avoid the placement of federally-guaranteed debt in capital markets that also manage Treasury securities. The LPO also developed the Federal Investment Partnership Program (FIPP) to enable private lenders to participate in DOE loan guarantee projects.

For budgetary purposes, the cost of a LPO loan guarantee (either self-pay or credit subsidy) is included in the DOE budget totals, while the disbursements and repayments of principal and interest on FFB-originated loans are scored as off-budget transactions but do affect government borrowing requirements.

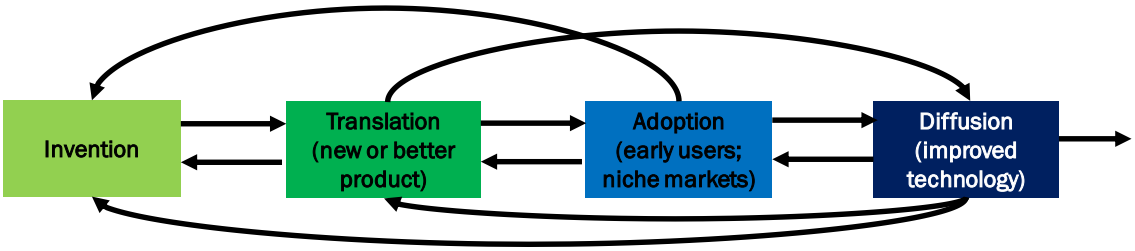
ATVM Direct Loans. The ATVM program consists of direct loans to eligible projects. Loans are approved by LPO, and LPO is authorized to draw the funding directly from the Treasury. Budget scoring of the direct loans is similar to loan guarantees. The cost of the loan (i.e. the net present value of the expected value of the cash flows) is scored against the DOE budget totals. All ATVM loans are supported by previously enacted credit subsidy appropriations. The loan disbursement and repayment cash flows are scored as off-budget transactions but do factor into government borrowing requirements.

Tribal Energy Loan Guarantee Program. This program authorizes loan guarantees to Tribal Governments for a variety of energy development projects on tribal lands. The costs of loan guarantees are supported by a previously enacted credit subsidy appropriation.

LPO Administrative Costs. The LPO charges fees to offset administrative costs in reviewing loan and loan guarantee applications. Fees under the Title XVII loan guarantee program are intended to make that program fully self-funded; the program has accumulated a net surplus of fees. Administrative costs of the ATVM program also are recovered through fees; however, there is a statutory cap on administrative costs of $100,000 or 10 basis points of the loan.

history of credit performance and commercial operation. Once the technology is proved at scale by DOE risk-sharing for the first few projects, the private market takes over.

Figure 3. Process of Technological Innovation



The processes of technological change, adoption and diffusion typically involve a continuing series of inventions and translations that require new research and development, while adoption and diffusion continually influence invention and translation.
Source: Adapted from E.S. Rubin. (2005); "Report to the President on Accelerating the Pace of Change in Energy Technologies Through an Integrated Federal Energy Policy."

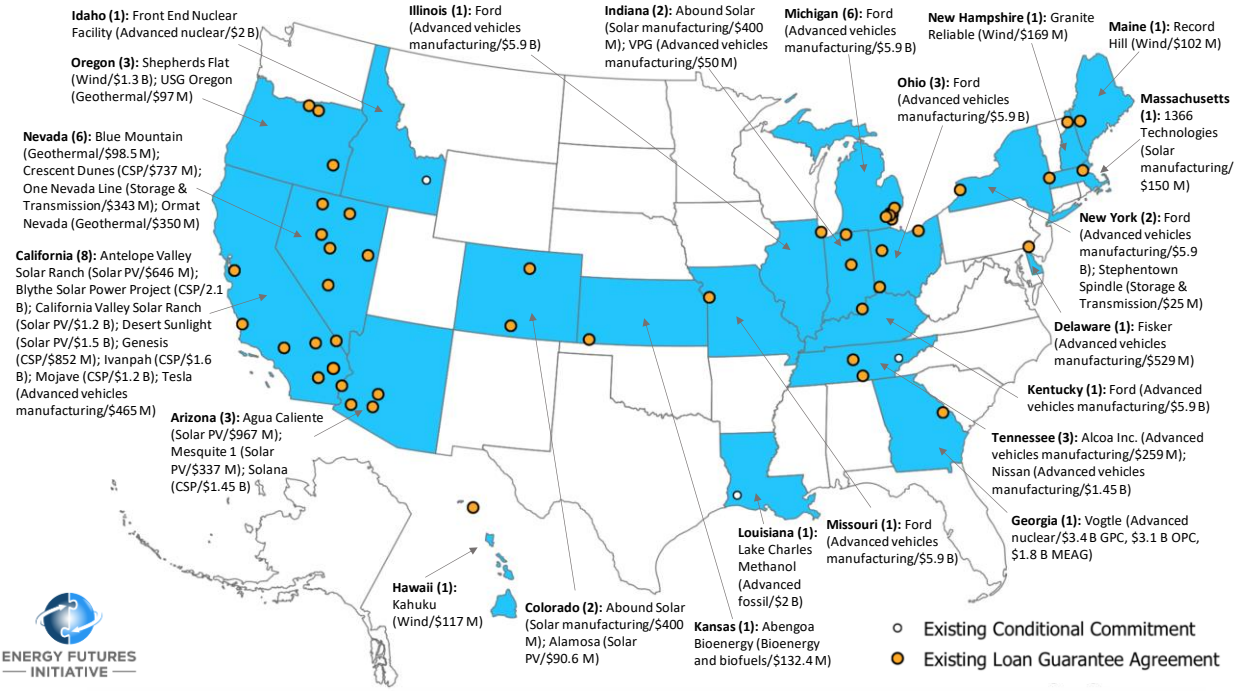
The programs administered by LPO are quintessential public-private partnerships that provide credit support to help de-risk projects and thus leverage private sector investment capital investment. Current law authorizes LPO to issue Title XVII loan guarantees for up to 80 percent of eligible project costs; direct loans under the ATVM program can cover up to 100 percent of eligible project costs. LPO however, has been highly successful in leveraging greater partnership shares, with a current portfolio average of 60 percent federal/ 40 percent non-federal. Thus, the non-federal partners have substantial "skin in the game." The portfolio of technologies in the LPO portfolio reflect the broad variation in energy resources, needs and capabilities across the regions of the country (Figure 4).

This portfolio has included many key first-of-a-kind commercial scale deployments of innovative energy technologies, including:

- the first new nuclear power plant to begin construction in the United States in more than thirty years;
- one of the world's largest wind energy projects;
- the initial deployment of solar photovoltaics and solar thermal power generation projects at utility scale; and
- more than a dozen new or retooled auto manufacturing plants across the country.

These programs have helped sustain the United States as a leader in innovative, clean energy technologies and advanced auto manufacturing in the face of increasingly stiff international competition, especially from China.

Figure 4. DOE's LPO Project Portfolio: Diverse, Regional, High Impact



Title XVII Loan Guarantee Program. The Title XVII program was authorized by the Energy Policy Act of 2005 (EPACT 2005) and signed into law by President George W. Bush.[2] The Act authorizes LPO to issue loan guarantees to support the commercial deployment of innovative clean energy technologies that reduce, avoid, or sequester greenhouse gases.[3] The Title XVII program applies to a broad range of energy technology areas, identified through funding solicitations, including advanced fossil energy, advanced nuclear energy, and renewable energy and energy efficiency.[4]

Figure 5: Launching the Domestic Utility-Scale Photovoltaic Market

LPO was instrumental in launching the utility-scale solar photovoltaic (PV) solar industry in the United States. In 2009, there were no utility-scale PV projects larger than 100 MW in the country. At that time there was only a total of 22 MW of utility-scale PV capacity installed domestically, and the U.S. Energy Information Administration (EIA) forecast only 140 MW of total utility-scale PV solar capacity would be installed by 2015.[5,6] Solar developers were unable to secure the necessary financing for construction of large projects, even though projects had firm offtake contracts and substantial equity in hand.

In 2011, LPO provided more than $4.6 billion in loan guarantees to support the first five utility-scale solar PV facilities larger than 100 MW.[7] Since then, the private sector has taken over and individually financed at least 45 more utility-scale PV projects, resulting in a 531% increase in installed capacity.[8] By 2015 there were over 12,000 MW of solar PV capacity installed at utility scale.[9] Many of the banks that financed these projects, such as John Hancock, Bank of America, and Citigroup, were banks that worked with LPO through the Financial Institution Partnership Program (FIPP) in financing the first five utility-scale PV projects.[10] The launch of the domestic utility-scale PV industry demonstrates the critical role LPO plays in reducing risk for innovative technologies and creating a financing model that can be adopted by the private sector.

Because the deployment of innovative technologies at commercial scale entails market, technology, and scale-up risk, commercial lenders are often unwilling to take on the risk of financing this new technology until the technology has a history of performance. Congress envisioned the Title XVII program as a programmatic vehicle for helping to fill this critical gap in the marketplace – also known as the "valley of death" in the finance world.[11] By providing project developers debt financing for the first commercial deployments of a new technology, LPO bridges this financing gap. Once there is proof of concept of the new technology, LPO stops providing financing and lets the private market take over.[12] This type of support from the federal government has demonstrated impact in encouraging technology advancements and maintaining U.S. footing as a leader in the rapidly evolving global clean energy sector (Figure 5).[13]

Advanced Technology Vehicles Manufacturing Program. The Advanced Technology Vehicles Manufacturing (ATVM) program was authorized under Section 136 of the Energy Independence and Security Act of 2007 (EISA), also signed into law by President George W. Bush. It authorizes LPO to provide direct loans to auto manufacturers and component suppliers to manufacture fuel-efficient vehicles and qualifying components in the United States.[14] The ATVM program has served a critical role in the marketplace by providing low-cost, long-term financing to expand U.S. auto manufacturing and assist the auto industry in achieving fuel economy standards, while sustaining and creating domestic manufacturing jobs (Figure 6).

Figure 6: Revitalizing Domestic Auto Manufacturing

LPO has committed more than $8 billion in direct loans to automakers to help revive the U.S. auto industry. This investment supported the production of more than 4 million advanced technology vehicles.[15] Key investments by LPO include:

- A $5.9 billion loan to Ford Motor Company, which has positioned the U.S. auto industry as a global leader in fuel-efficient vehicles.[16] Ford utilized the loan to retool and modernize 13 facilities in six states to manufacture fuel-efficient vehicles, such as the F-150, Escape, Focus, and C-Max, and components, including the EcoBoost engine.[17] The loan to Ford preserved and created more than 33,000 American manufacturing jobs.[18]
- A $465 million loan to Tesla, which the company used to reopen a shuttered automotive manufacturing plant in Fremont, California and to produce battery packs, electric motors, and other powertrain components.[19] The construction of the Tesla plant initially created more than 1,500 full time jobs in California;[20] the company now employs 13,000 individuals in the United States and supports thousands of additional jobs through the supply chain.[21] Tesla repaid its loan nine years earlier than required.[22]
- A $1.4 billion loan to Nissan, which was used to retool Nissan's Smyrna and Decherd, Tennessee plants to manufacture the Nissan Leaf and its components in the United States.[23] This loan facilitated the onshoring of the Nissan Leaf, supporting 1,300 American jobs.[24]

Tribal Energy Loan Guarantee Program. The Tribal Energy Loan Guarantee Program was authorized in Title V of EPACT (2005). The program is authorized to guarantee up to 90 percent of a loan made to an Indian Tribe for energy development or expanded provision of electricity on Indian lands. The program can support innovative technologies, but unlike the Title XVII Loan Guarantee Program, eligibility is not limited to innovative technologies. The statute set an authorization limit of $2 billion on the aggregate amount guaranteed at any

time. The cost of loan guarantees is supported by an authorization of appropriations for credit subsidy costs.

The program was not funded until FY 2017, when Congress provided an appropriation of $9.0 million: $8.5 million for credit subsidy costs and $0.5 million to cover administrative costs. The DOE Office of Indian Energy Policy and Programs manages the program, with credit underwriting handled by the LPO. DOE has not yet issued regulations delineating program requirements or procedures, nor has it formally solicited applications.

The LPO Rigorous Management Process Has Established a Strong Track Record

The LPO is an office within DOE with a structure similar to that of a lending bank. The organization has separate teams managing all aspects of a loan from origination to monitoring. This includes a portfolio management division and risk management division that actively monitors the loan for its full tenor and a separate team for addressing any environmental concerns related to the project.[25] The LPO team is highly experienced in project finance, with employees who have previously worked in both the private and public sectors managing multi-billion-dollar projects.[26]

A key differentiator between LPO and a commercial lender is that the LPO process benefits from a uniquely detailed evaluation of technical risks, drawing on the scientific and engineering expertise through the Department and the National Laboratories. The Government Accountability Office reported that private lenders found LPO's due diligence to be as stringent, if not more stringent, than is often found in the private sector.[27]

The LPO Credit Underwriting Process. The strong performance of LPO's portfolio reflects the implementation of a rigorous credit underwriting process. The process is modeled after private sector processes, and the principal steps are publicly outlined in DOE regulations. The two-step credit underwriting process begins with an initial review prior to detailed underwriting. The second stage involves an in-depth assessment of a project's management structure, technology risk, market risk, and financial viability. LPO conducts extensive due diligence on the application, including rigorous financial, technical, legal, environmental, and market analysis by outside advisors and DOE's professional staff of qualified engineers and financial experts.

The LPO process includes several key checks and balances. LPO recommendations to issue a loan or loan guarantee commitment must be reviewed and approved by a Departmental Credit Review Board, chaired by the Deputy Secretary, and comprised of senior officials representing the major Departmental organizational elements. The LPO also is overseen by a Departmental Risk Committee, chaired by the Chief Financial Officer, that monitors loan disbursements. Finally, the LPO is supported by the Departmental Project Risk Management Committee, which regularly convenes risk management experts from across the Department to assess enterprise-wide project management risk.

Loan and loan guarantee agreements developed by LPO include a variety of risk management tools, including performance-based milestones for disbursements, covenants, off-ramps,

special contingency funds, and provisions for cash sweeps and accelerated repayment.[28] LPO has worked with projects of different sizes and complexities, and employs a tailored approach rather than a one-size-fits-all approach. For example, the tenor of a Title XVII loan guarantee for a power generation project will closely mirror that of the revenue stream, or power purchase agreement. The LPO lending platform has demonstrated that it can be readily adapted to critical energy infrastructure projects.

Further, LPO utilizes extensive monitoring provisions, including covenants and milestones, to ensure borrowers are meeting expectations in the project execution stage. Additionally, LPO has in place a monitoring system through which it tracks market, regulatory, and counterparty risks, among other factors that could affect a borrower's ability to repay a loan.[29]

The Successful LPO Track Record. The LPO Track Record represents a highly successful program that has protected taxpayer interests while advancing national energy and economic policy goals. Even though LPO's mission to support innovation carries an inherent degree of financial risk, the office has maintained a strong track record that, as already noted, rivals that of the private sector (Table 1).[30]

Table 1. Financial Summary of LPO Portfolio as of June 2017[1]	
Principal Amounts	
Loans and Loan Guarantees Issued	$31.98 billion
Loans Disbursed	$25.74 billion
Principal Repaid	$7.31 billion
Financial Metrics	
Interest Paid to the Treasury	$1.98 billion
Loan Losses (Actual or Estimated)	$0.81 billion
Losses as a Percentage of Total Commitments	2.22 %

Source: DOE Loans Program Office, https://www.energy.gov, accessed February 22, 2018

LPO manages a portfolio of about $32 billion in loans and loan guarantees, which has leveraged $20 billion in private equity investment to create a total project portfolio totaling $50 billion.[31] All loans and loan guarantees financed through the Treasury carry interest rates that are set at a premium to the cost of Treasury borrowing. Project sponsors commonly begin repayment of their loan once the project has completed construction. With construction of almost all of LPO projects completed, the majority of portfolio loans are currently in the repayment period.[32] LPO's portfolio has generated almost $2 billion in interest payments for the American taxpayer, and the program is expected to bring in roughly $5 billion over the course of the investments.[33] [34] Interest payments received to date exceed portfolio losses of $810 million.

The total economic and societal benefits of the program are significantly larger, reflecting the value creation associated with the economic and trade benefits of new technology industries as well as the value associated with creating or sustaining high quality jobs.[35] [36] To date, the $50 billion in total project investment has created or saved 56,000 American jobs, boosted

local economies and accelerated multiple new energy markets in the United States.[37] In addition to these metrics, as of December 2016, LPO projects resulted in 34.7 million metric tons of avoided CO2 emissions, produced enough clean energy to power over 1 million average American homes annually, and saved 1.7 billion gallons of gasoline. These estimates will continue to increase as completed projects continue operations and more projects complete construction and become fully operational.

The DOE Loan Program Office at a Crossroads

At present, the LPO still has total credit authority estimated at $44.6 billion in credit authority, with a balance of $38.9 billion remaining, assuming the finalization of $5.7 billion in conditional commitments. The Tax Cut and Jobs Act of 2017 included specific provisions that provide tax incentives for the pending conditional commitments, increasing the likelihood of their finalization. The LPO credit resources are currently allocated among a set of technology-specific funding opportunity solicitations as summarized in Table 2.[38] How might these remaining resources best be deployed in the public interest?

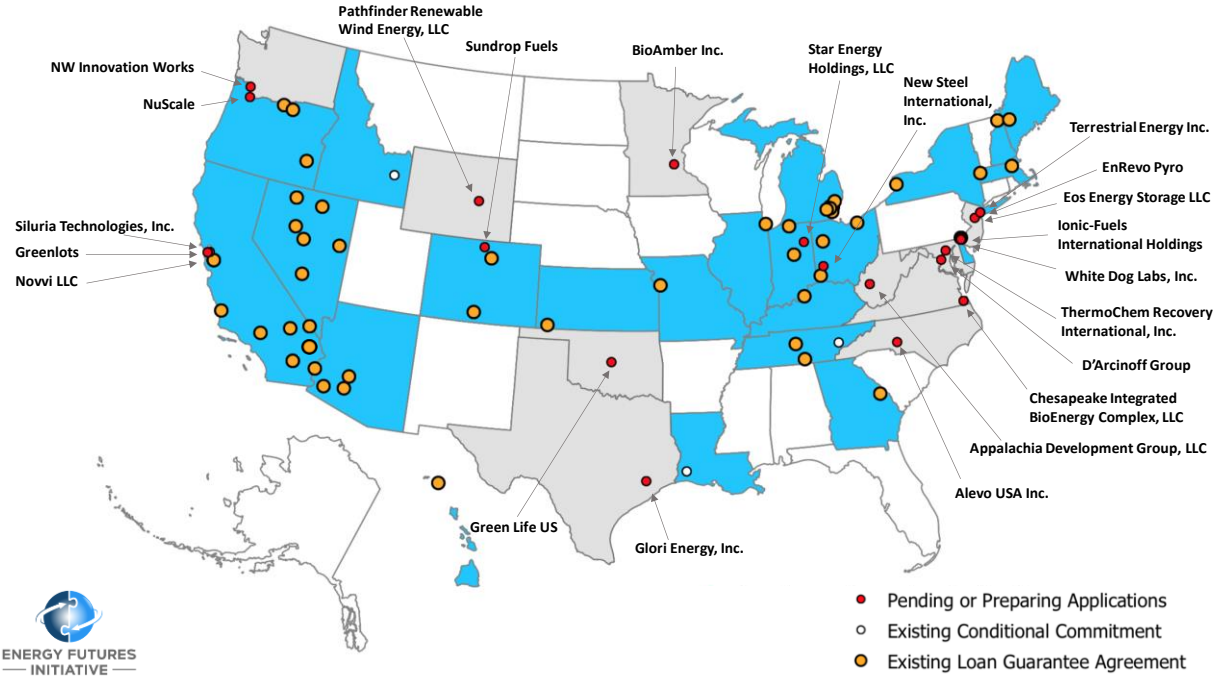
Table 2. Estimates of LPO Credit Authority ($billions)

Programs	Current Remaining Authority	Pending conditional commitments	Net amount available	Credit subsidy appropriations support
Title XVII Volume Caps (self-pay authority)				
Advanced fossil energy	$8.5B	$2.0B	$6.5B	None (self-pay)
Advanced nuclear energy	$12.7B	$3.7B	$9.0B	None (self-pay)
Nuclear – Front End	$2.0B	-	$2.0 B	None (self-pay)
Renewable energy and energy efficiency (self-pay)	$2.5B	--	$2.5B	None (self- pay)
Subtotal (Title XVII self-pay)	**$ 25.7B**	**$5.7 B**	**$20.0 B**	
Estimated Renewable Energy and Energy Efficiency (supported by credit subsidy appropriation)	$1.1B	-	$1.1 B	$160 million
Subtotal (Title XVII) (self-pay and credit subsidy appropriation)	**$26.8B**		**$21.1B**	**$160 million**
ATVM (supported by credit subsidy appropriation)	$17.7B	--	$17.7B	$4,333 million
Estimated Tribal Energy Loan Guarantee Volume (supported by credit subsidy appropriation)	$0.1B		$0.1 B	$8.5 million
TOTAL	**$44.6B**	**$5.7B**	**$38.9B**	

Note: *Title XVII self-pay loan guarantee authority is subject to volume caps set in appropriations acts. Title XVII loan authority supported by credit subsidy appropriations is estimated based on the coverage of the appropriation. ATVM loan authority is estimated based on coverage of the remaining credit subsidy appropriation, subject to a statutory volume cap of $25 billion. Tribal Energy Loan Guarantee authority is estimated based on coverage of the current credit subsidy appropriation, subject to a statutory volume cap of $2 billion.* Source: EFI estimates, drawn from Budget of the U.S. Government Fiscal Year 2018 and 2019 budget documents.

As of December 2016, more than 70 applications were pending action by DOE. These applications were submitted in response the Department's current technology-specific open solicitations for projects.[39] This pipeline of projects appears to be in limbo; the Administration's FY 2018 budget proposal to terminate the program is waiting final Congressional action in the FY 2018 appropriations process. The Administration's FY 2019 budget proposal also proposes to terminate the LPO programs. The status of these projects -- whether some project sponsors have withdrawn applications or additional new applications have been filed -- is unknown. These applications were developed in good faith and submitted to LPO (together with filing fees) with the expectation that LPO would exercise its responsibility to conduct an evaluation and make a decision based on project merit. Executives from 17 companies wrote to Congress that "The LPO is a win-win for taxpayers, American energy innovation, and the communities and states where these investments are made…Further, the current $41 billion of authority in the LPO, with its focus on important energy infrastructure, represents a significant here-and-now down payment on the $1 trillion goal the President has set for U.S. infrastructure spending."[40]

Figure 7. Existing, Pending or Preparing LPO Applications



While DOE has not made information public on the specific projects in the application pipeline, a review of publicly available information identified a total of 22 companies that made public statements regarding applications submitted to LPO. As already noted, 17 companies co-signed a letter to Congressional leadership on January 4, 2018 stating that they have submitted, or are preparing, applications and are seeking Congressional support for continuation of the program. Another five companies were identified by public statements on their websites that they have filed loan guarantee applications.[41] When combined with the

projects currently in the LPO portfolio, the projects in total would span 32 states, as shown in Figure 7.

One project that has received a Title XVII loan guarantee conditional commitment and is awaiting final action is the Lake Charles methanol project. On December 21, 2016, LPO extended a conditional commitment for up to a $2 billion loan to Lake Charles, LLC to construct the nation's first petroleum coke-to-methanol facility.[42] The Lake Charles project would employ carbon capture technology and, once constructed, could be the world's largest industrial carbon capture project. This establishes a new technology pathway for enabling fossil fuels in a future low carbon economy. The carbon captured by the project will be used for enhanced oil recovery (EOR) in Texas. It is anticipated that the Lake Charles project will create 1,000 full-time construction jobs and 200 permanent jobs in Louisiana, with another 300 jobs created from the related EOR activities in Texas.[43] The conditional commitment for Lake Charles remains pending and its fate is uncertain. The recently passed reform and extension of the 45Q tax credit should enhance the economic feasibility and credit worthiness of this and other future carbon capture, utilization, and storage projects.[44]

On September 29, 2017, DOE issued a new loan guarantee conditional commitment to the Vogtle nuclear power plant project for up to $3.7 billion.[45] The Tax Cut and Jobs Act of 2017 clarified that the project will also be eligible for a Production Tax Credit.

The Trump Administration FY 2019 budget proposal would terminate all further LPO activity other than finalization of the new conditional loan guarantee commitment to the Vogtle project. EFI estimates that the FY 2019 budget proposal would generate budget savings totaling $369 million relative to the new non-defense discretionary budget caps, using Congressional Budget Office scorekeeping procedures. However, it is important to recognize that these budget "savings" are not actual cash flow savings to the deficit, but rather budget accounting adjustments (Figure 8).

Alternatively, Congress could re-focus the program to support innovative approaches to modernization of energy infrastructure projects (outside the current statutory eligibility) as part of the broader $1.5 trillion infrastructure investment package being proposed by the Trump Administration. Based on the experience with other federal infrastructure credit support programs, the current balance of $39 billion in LPO authority (after finalization of Vogtle and Lake Charles) could potentially leverage a total of $100 billion of total capital investment in innovative approaches to modernizing energy infrastructures. Described below are the outlines of a proposal and a process to address both the existing application pipeline and re-position the program to more fully help meet the investment needs for a modernized national energy infrastructure.

Opportunities to Address Broader Energy Infrastructure Investment

The United States has an advanced yet aging energy infrastructure that is facing increasing challenges to system performance, as well as the ability to adapt to changing market conditions.[46] It's fair to say that our current energy infrastructures, while aging, are not "crumbling". They are however, in need of modernization to meet 21st century challenges and

opportunities. Also, as noted, global competitors of the U.S. are investing heavily in building out their energy infrastructures. These new builds will accommodate advanced technologies and reflect 21st century capabilities and capacities. Estimates of future investment requirements across all components of energy and enabling infrastructures sufficient to maintain the U.S. edge in competitiveness, security, safety and environmental responsibility, are enormous.

Growing Need for Maintenance and Expansion of Conventional Energy Infrastructures. Much of U.S, energy infrastructure was built during the rapid expansion of the economy in the post-WWII period, making it 60+ years old. Some is older still, dating back to rural electrification and the days of city gas lighting. For the electricity sector -- the most critical of all energy infrastructures -- the American Society of Civil Engineers estimates that there is currently a $177 billion investment gap for electricity generation, transmission and distribution (T&D) between 2016 and 2025.[47] The 640,000 miles of high-voltage transmission lines in the contiguous U.S. are reportedly near full capacity.[48] The Electric Power Research Institute (EPRI) estimated that between 2011 and 2030, a net investment of $338-476 billion would be required to modernize the power delivery system.[49]

In the oil and gas sectors, a large percentage of natural gas transmission lines were constructed prior to 1980, while oil refineries have operated at approximately 90% capacity since 1985 with few new builds.[50] Nearly half of U.S. natural gas transmission and gathering pipelines were built in the 1950s and 1960s.[51] Safety upgrades alone are costing natural gas utilities approximately $22 billion per year on existing T&D systems.[52] The American Petroleum Institute estimates there is a need for $1.06-1.34 trillion in total capital expenditures for new infrastructure development between 2017 and 2035.[53] This includes oil, gas, and natural gas liquids pipeline development, refining, storage, gathering and processing pipeline systems and surface and lease equipment.

It is also worth noting the growing importance of inland waterways and ports as key links in the energy infrastructure supply chain. The U.S. is now exporting both oil and gas on coastal waterways and via pipeline to Mexico; a substantial amount of oil moves on inland waterways. Waterborne infrastructure supports 62% of U.S. crude petroleum imports, and helps transport 20% of all crude petroleum, 6% of all coal, and 14% of other fuel oils.[54] The U.S. is now producing substantial biofuels, much of which also moves on inland waterways. In addition, centers of population growth and the associated fuel demand – both biofuels and oil – are increasingly on U.S. coasts.

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Figure 8. Measuring the LPO's Impact on the Treasury and the Taxpayers

The budget scoring of the LPO credit authority is a complex mix of cash flow and accrual accounting concepts, where reported costs represent a mixture of current cash outlays, net present value estimates of future costs, and probabilistic estimates of loan repayments and recoveries. Some of these costs are recorded on-budget, while others are recorded in off-budget financing accounts. Consequently, actions that are reported to have an immediate budget scoring "savings" may have little or no impact on federal cash outlays or Treasury borrowing costs and may have longer-term costs to the deficit and borrowing. Several of these anomalies are highlighted below.

When Congress considered the Trump Administration proposal to close down LPO in the FY 2018 budget (re-proposed for FY 2019), the Congressional Budget Office assigned the proposal a budget scorekeeping credit of slightly more than $400 million. While the scoring is consistent with current federal budget scorekeeping guidelines, it does not measure the full net effect on federal cash outlays (and deficits) and Treasury borrowing requirements.

First, it is important to note that LPO currently contributes net positive cash flows to the Treasury from its portfolio. For the last full fiscal year (FY 2017), OMB reported that the ATVM program recorded repayments and prepayments of over $1 billion. The Title XVII program recorded repayments and prepayments of $360 million, offset in part by new loan disbursements of $275 million. Budget scorekeepers record these as off-budget transactions that are not counted in budget totals; nonetheless they represent net cash flow to the Treasury. LPO reports that through June 2017 that the Treasury has collected a total almost $2 billion in interest payments from projects in the LPO portfolio. OMB reports total interest payment collections of about $450 million in FY 2017 alone. Loans originated through the Federal Financing Bank (FFB) charge LPO project borrowers a premium above the cost of Treasury borrowing, resulting in net interest revenues to the Treasury. The combined government-wide transactions of the FFB contributed net federal deficit reduction of $334 million in FY 2017.

If the current portfolio is generating net cash flow to the Treasury, how would termination of the program result in budget savings? Under conventional budget scoring rules, termination of the LPO Title XVII loan guarantee program would result in a one-time, non-cash budget accounting savings adjustment. Using the estimates of remaining Title XVII loan guarantee authority in Table 1, the termination of the program (other than the two current conditional commitments) has a budget scoring reduction of $20 million, or 1 % of the $20.0 billion face value of remaining self-pay loan guarantee authority authorization. The savings stem from the elimination of a bookkeeping charge of 1 percent when the loan volumes were initially set in several appropriations Acts a decade ago. At that time, the Congressional Budget Office asserted that the loan guarantees would not be fully self-paid and applied a 1 percent scorekeeping adjustment. This adjustment proved to be erroneous in fact and would now be erased. Both the original scorekeeping charge and the reversal of this charge are merely bookkeeping adjustments, so the rescission of the loan guarantee authority would neither reduce cash outlays nor reduce Treasury borrowing requirements. In fact, the bookkeeping credit of $200 million frees up cap space within the new Bipartisan Budget Act of 2018 (BBA) spending caps to enable additional new spending for other purposes.

In addition, termination of the current balance of the roughly $169 million in remaining credit subsidy appropriation (roughly $160 million for Title XVII and $9 million for tribal energy) has a scoring reduction of $169 million. The so-called credit subsidy is actually a reserve in the event of a possible future default, so the moneys do not actually result in cash outlays unless future loan guarantees are issued, and the guaranteed projects subsequently default on those guarantees. As is the case with the Title XVII loan guarantee authority, rescinding this balance of remaining credit subsidy appropriation in essence allows Congress to increase new appropriations for direct spending dollar-for-dollar without being charged to the new BBA spending cap. This action would actually increase federal cash outlays and borrowing in the near term.

Termination of the ATVM program has no scoring budget scoring impact. The ATVM credit subsidy funding was originally appropriated as an emergency appropriation, so rescission of these funds cannot be credited as a savings against the new BBA spending caps. The credit subsidy would otherwise be applied to support new loans in the future, so allowing the funds to be used to support new loans would actually generate net positive returns to the Treasury over the loan repayment period, since the interest rates on the loans would be set at a premium to Treasury borrowing costs.

Finally, it is important to note that a credit support program, such as Title XVII and ATVM, has a smaller budget footprint than a direct grant program such as the proposed Transformational Projects Program (TPP), whether measured in terms of budget scorekeeping rules or actual net cash flow from the Treasury. For budgetary purposes, the credit support programs are scored based on expected net present value cost to the government, i.e. the net present value of the expected repayment of the loan, taking into account the possibility of default and the recovery of assets in the event of default. The scoring impact likely would be in the range of 0-20 percent of the face value of the loan. By comparison, a TPP grant would score at full face value. Looking at cash flow, an LPO loan or loan guarantee funded through the FFB would carry an interest rate premium to the cost of Treasury borrowing, resulting in a future cash flow stream in excess of Treasury repayment requirements. The TPP grant, once disbursed, would generate no future repayment.

These changes have contributed to congestion in the Gulf of Mexico, home to over 50% of U.S. refining capacity, the Strategic Petroleum Reserve, and significant export infrastructure. This has increased the need for movement of product as well as enhancements of the associated conventional infrastructure. The American Society of Civil Engineers estimates that waterborne infrastructure will have a $1.5 billion average annual investment gap between 2016 and 2025, which will increase to $1.9 billion between 2026 and 2040.[55] Unlike other energy infrastructures, much of this is solely a Federal responsibility, a serious concern in times of significant budget constraints.

Trends in the Energy Sector that Point to Need for Innovations in Infrastructure. These numbers provide examples of how much capital is needed for maintaining the functions of *existing* energy infrastructures; they do not necessarily capture infrastructure innovations that are needed to enable new services and technologies, opportunities, and address security threats and U.S. economic competitiveness in a rapidly changing energy environment.

Several trends in energy markets have been driven by innovation; these will require a corresponding focus on innovations in energy infrastructure. Looking forward, other general trends in the economy also have the potential to fundamentally change the energy landscape and infrastructures of the future and are important for evaluating the potential for specific investments to meet growing market needs. These recent trends can be grouped into general areas described below.

Changes in the U.S Energy Supply Profile. In the past decade, the technology-enabled unlocking of shale gas and tight oil resources in the U.S. has dramatically altered the scale and location of available oil and natural gas resources. The infrastructure that supports these changes, the costs of producing these resources, and the growing U.S. role in global oil and gas markets must be accommodated by both the private and public sectors.

There have also been dramatic increases in wind and solar as fuels for power generation. Reductions in the costs of both technologies have improved their respective economics and now represent the lowest cost options for new power generation capacity in many markets. In the past several years, wind and solar PV have constituted almost 70% of new generation capacity.[56]

The rise of solar PV is particularly notable because of the technology's unique technical characteristics: it can be deployed effectively at every scale, from a single residential household installation involving kWs of generation capacity, to traditional utility-scale facilities involving 100s of MWs of capacity. This deployment flexibility has resulted in the widespread growth of distributed solar generation. At the end of 2017 there were over 1.5M solar installations in the United States, which includes 15.6 Gw of "small scale solar" (including residential and commercial rooftops) and 23 Gw of utility scale solar.[57] It is also notable for being part of the technology- as opposed to resource -based paradigm.

Changes in the Focus of Energy Innovation from Resource- to Technology-based Energy Systems. The movement towards energy technologies with little or no fuel cost (wind and solar), underpins a broader shift away from an energy system that is "resource-centric" to one

that is increasingly "technology-centric". This comes with an entirely new set of infrastructure and investments. In the old energy paradigm, those with access to the lowest cost resources, e.g. the most productive and easily developed oil reservoirs, were at a natural commercial advantage. In the new energy paradigm where fuel costs are less relevant, better clean energy technologies will capture the larger market share and value.

Technology-focused innovation has enabled two-way flows of electricity and created value in demand response across the system. It has allowed consumers to generate their own electricity from rooftop solar panels and to sell it back to the grid. The growing infrastructure of distributed solar PV facilities in the United States and other parts of the world is part of a broader trend towards energy systems that are more decentralized. In such systems, distributed generation, energy storage and other smart energy devices consume, store, and produce energy in a much more dynamic and system- responsive manner.

Digitalization, Big Data Analytics and Smart Systems. The use of digital information, analytics, and networks has grown exponentially over the last decade. Roughly 7.5 million Internet-connected devices are added each day across the world, and by 2030 there are expected to be around 50 billion digital devices enabling the "Internet of Things" and the "Fourth Industrial Revolution." This has unlocked significant potential in the use of software algorithms to perform tasks — visual perception, understanding and communicating with natural language and adapting to changing situations — that normally require human intelligence and leverage automation capabilities.[58]

Many of the functions of electric grid operators are improved by and have the potential to be optimized by automation. Distribution automation, which uses digital sensors and switches with advanced control technologies to automate feeder switching, monitor voltage and equipment health, and manage outages, voltages, and reactive power, can greatly improve speed, cost, and accuracy of these key functions required by smart grids.[59] While many of these processes already rely on SCADA, a broader and deeper SCADA architecture that processes more quality data at faster speeds can improve operations and maintenance, increase efficiency and defer major capital investments.[60]

Electrification and Electricity-dependence. Electricity has become a central enabler of the economy with the growing proliferation of digital and smart technologies, and an increasing focus on decarbonization. In 2016, for the first time ever, global investment in electricity sectors were higher than in all other energy sectors, including oil and gas, the historical owners of first place.[61]

Electrification is growing across industry, buildings, and other end-use sectors, the trend is most pronounced in the transportation sector. Worldwide, markets are developing rapidly for electric vehicles. This includes battery-electric (BEV), plug-in hybrid electric (PHEV) and fuel cell electric passenger light-duty vehicles (FCEVs). In 2016, the global EV stock exceeded two million after surpassing 1 million in 2015.[62] In 2016, six countries achieved an electric car market share above 1% of their total, including Norway, the Netherlands, China, France, the United Kingdom, and Sweden.[63]

Due to the trends in digitalization, electrification, and smart systems, cybersecurity has emerged as a critical issue that must be addressed to protect the enormous value creation associated with electricity and all that it enables. Increased automation, and two-way flows of information will increase the energy sector's exposure to cyberattack exponentially.

Demographics, Urbanization, and the Emergence of Smarter Cities. As of November 2017, the U.S. population was 326 million.[64] While U.S. population more than doubled between 1950 and 2010[65], population growth has slowed to a 0.7 percent increase between 2015 and 2016.[66] By mid-century, the total U.S. population is projected to reach 400 million people, with an average annual percent increase of 0.61.[67]

Population trends between urban and rural areas in the U.S. have differed markedly in the past. While the number of urban residents has increased approximately 500 percent since 1910, the number of rural residents has only increased by 19 percent.[68] From 2000 to 2010, urban population growth increased by 12.1 percent, which outpaced the overall rate of 9.7 percent. [69] At present, only one-fifth of the population lives in rural areas.[70] Projections to 2050 indicate an increasingly urban population, while rural areas could experience a slight population decline. The southern, western, and coastal areas of the U.S. continue to see greatest population increases. [71,72] These urbanization and geographic trends will have implications for the U.S. energy sector, demand for smarter cities and the associated infrastructures.

Decarbonization, the Changing Fuel Mix and Energy Efficiency. The energy sector is the leading source of GHG emissions and all meaningful pathways toward the mitigation of the worst effects of climate change of the coming century demand enormous reductions in absolute energy-related emission levels. Deep decarbonization imperatives are the principal drivers of challenges for accelerating the clean energy transformation that will include a range of associated impacts on infrastructures.

Emerging smart cities and transportation systems that can contribute to deep decarbonization rely on digital platforms. The trend toward smarter cities is supported by the growth and deployment of these technologies, as well as the growing interest of stakeholders, including citizens, city authorities, local companies, and industry groups to work together more efficiently and effectively.[73] In the transportation sector, cars, trucks, planes, ships, trains, and their supporting infrastructures are becoming smarter and more connected due to these digital platforms. The trend toward automated, connected, electric, and shared (ACES) vehicles are enabled by digital devices and platforms that create vehicle-to-vehicle and vehicle-to-infrastructure connections.

Further, U.S. energy demand has remained stagnant since the turn of the century and is expected to remain relatively flat to 2040 under a variety of economic, technology, and energy price scenarios.[74] For the U.S. power sector, even though the U.S. economy grew by just over 10 percent from 2008 to 2015, the annualized electricity demand growth has been zero over that same period.[75] A major driver of flat demand has been significant increases in energy efficiency measures. Efficiency has implications for infrastructure build-out, including infrastructure avoidance.

Innovative Energy Infrastructures, the DOE Loan Programs and the Proposed Transformative Projects Program (TPP). These trends have profound implications for energy infrastructure. Technology-focused innovation has reduced the relative value of energy resources and enables distributed generation and decentralization of electricity generation. Electrification of the transportation system comes with an entirely new set of needs and requirements for energy infrastructure. Digitalization suggests that automated systems, sensors, switches and advanced control technologies, coupled with electrification, the fundamental role of electricity as the uber-infrastructure and cyber-security platforms should be considered innovative energy infrastructures.

Urbanization requires different infrastructure configurations to enable smart cities and transportation. At the same time, the lack of access to broadband in large parts of rural America – a key enabler for innovative energy infrastructures-- diminishes the value of decentralized power generation and its associated energy infrastructure implications for rural consumers. Efficiency improvements must be factored in to forecasts for capital-intensive infrastructure and the imperatives for deep decarbonization suggest that infrastructures that enable this outcome such as CCUS pipelines and disposal could be considered innovative energy infrastructures.

This takes the discussion back to the DOE loan programs. A requirement for both the Title XVII program and the ATVM program is that the associated loans and loan guarantees be used for "innovative" projects. The trends described above suggest many valuable and transformation opportunities for backstopping innovative infrastructure investments. Table 3 lists the current LPO projects and illustrative innovative infrastructure technologies.

As noted earlier, DOE's loan programs provide ideal vehicles for supporting the Administration's proposed *Transformative Projects Program*. The proposed criteria for the TPP program include infrastructure projects that significantly improve infrastructure performance; substantially reduce user costs for services; introduce new types of services; and improve services based on other related metrics. Energy infrastructures and broadband would be covered by this program. Funds could be used for demonstration, project planning, and capital construction. This combination (or the DOE loan programs on their own) could support critical infrastructure projects described above – smart cities, distributed systems, automation of substations, CCUS systems – as well as reduce the costs associated with the TPP, a grant program that would require substantial outlays (Table 3).

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Table 3. Current and Potential Eligibility in LPO Loan Programs

Examples of Project Eligibility Described in Current Solicitations	Examples of Expanded Set of Energy Infrastructure Investment Opportunities
Title XVII Loan Guarantee Program	
Renewable Energy & Energy Efficiency & Electricity Systems	
• Advanced Grid Integration & Storage (renewable energy generation, including distributed generation, incorporating storage; and Smart grid systems incorporating demand response) • Drop-in Biofuels (new bio-refineries or bio-crude refining processes; and modifications to existing ethanol facilities) • Waste-to-Energy (recovery from landfills, municipal solid waste, crop waste, or forestry waste) • Enhancement of Existing Facilities (powering non-powered dams or upgrading existing hydro facilities; and retrofitting existing renewable facilities with innovative technology (e.g. wind turbine retrofits) • Efficiency Improvements (improve or reduce energy usage in residential, institutional, and commercial facilities, buildings, and/or processes; and recover, store, or dispatch waste energy or underutilized renewable energy sources) • Deployment of Innovative alternative fueling infrastructure (EV battery charging stations, deployment of hydrogen, CNG, LNG or other alternative fuel infrastructure • Bundling of distributed electricity generation projects into a single financing	• Systems-level energy management solutions at the community or smart city scale • Systems-level energy management solutions for urban transportation systems • Application of platform technologies for digitization, big data analytics or artificial intelligence technologies to improve efficiency and effectiveness of electricity grids including incorporation of behind-the-meter applications • Innovative approaches for enhancing the reliability, resiliency or cybersecurity of electricity generation, transmission and distribution systems • New technologies and systems-management approaches to improving energy-water use efficiency in water resources infrastructure and water using technologies • Credit support to syndicate project financings by State Green Banks and Clean Energy Development financing programs
Advanced Fossil Energy Technologies	
• Advanced Resource Development (coal-bed methane and novel oil and gas drilling) • Low Carbon Power Systems (chemical looping and fuel cells) • Carbon Capture, including CO_2 capture and permanent geologic storage or utilization in enhanced oil recovery (EOR) • Efficiency Improvements (combined heat and power (CHP), industrial waste energy recovery, and high-efficiency distributed fossil power systems and microgrids)	• Carbon capture technologies and systems to capture CO_2 already airborne, including biological and terrestrial sequestration and direct air capture • Innovative approaches for expanding CO_2 pipeline, storage and injection infrastructure • Technologies for CO_2 utilization in products • New technologies and systems for reducing methane leakage from natural gas transmission and distribution infrastructure
Advanced Nuclear Energy	
• Advanced Nuclear Reactors (projects with state-of-the-art design improvements in fuel technology, thermal efficiency, modularized construction, and safety systems) • Small Modular Reactors (SMRs) • Uprates and Upgrades at Existing Facilities • Front-End Nuclear: uranium conversion or enrichment; nuclear fuel fabrication	• Manufacturing and deployment of nuclear supply chain components for advanced nuclear reactors • Innovative used nuclear fuel management and transport systems
ATVM Loan Program	
• Manufacturing of fuel efficient light duty vehicles and qualifying components • Manufacturing of components for alternative fueled vehicles, including battery charging systems, and hydrogen, CNG, LNG and other alternative fuels fueling infrastructure equipment	• Manufacturing of fuel efficient medium- and heavy-duty vehicles (trucks and buses) • Energy Efficient Improvements to other transportation infrastructure (e.g. port connectors, port, airport and rail transportation systems)

The Impacts of the Tax Cut and Jobs Act on Infrastructure Investment. Most of the existing energy infrastructure is privately—owned and the private sector will be responsible for planning, financing, and managing infrastructure modernization. The Tax Cut and Jobs Act of 2017 will enable the private sector to retain a greater share of net income that can be used to support financing of new energy infrastructure projects, should it choose to do so.

The dynamic modeling analysis of the Act prepared by the staff of the Joint Committee on Taxation estimated that nonfarm business investment in plant and capital assets could increase at a rate 0.9% higher than would be the case without the tax changes. This is estimated to result in a potential increase of up to $1.5 trillion in cumulative incremental capital investment over the next 10 years. Private firms will have to balance capital utilization decisions that allocate increased resources to capital investment and to workers or equity holders.

At the same time, the Tax Cut and Jobs Act of 2017 made debt financing less attractive to private firms, since the value of the deductibility of interest costs is reduced; in addition, for large firms, deductibility of interest costs are capped at 30% of net income. The availability of federal loan guarantees could provide an important signal to private firms contemplating increased capital investment to modernize energy infrastructures and could help offset the less favorable provisions affecting debt financing.

For the portion of energy infrastructures that are owned in the public sector, the public owners will not receive the same beneficial tax incentives from the Tax Cut Act. Some analyses suggest that the Act will have adverse impacts on state and local government budgets. This could create an additional need for increased public-private partnerships to leverage limited governmental financial resources in energy-related energy infrastructure investments.

It has been widely reported that U.S. energy infrastructures require substantial modernization over near- and longer-term timescales to enhance resilience, provide new services, and support economic growth and U.S. competitiveness in the global economy. Examples of projects that illustrate the potential scale of future investment in critical energy infrastructures and systems are highlighted below.

Recommendations: Expanding and Improving Title XVII and ATVM to Fund the Next Wave of Energy and Transportation Infrastructure

U.S. energy infrastructures need for modernization to support the U.S. economy and its leadership position in the rapidly expanding global economy, to create or retain good jobs and to provide enhanced services. To help fund the next wave of energy and transportation infrastructure, Congress could amend the Title XVII and ATVM programs to significantly expand their use and deploy LPO's existing $40 billion in loan authority, without the need for additional appropriations in the federal discretionary budget.

Program Enhancements to Support Financing of Innovative Energy Infrastructure. There are three general areas where DOE's current programs can be adapted and enhanced to enable

significant increases in private sector investment in innovative approaches to U.S. energy infrastructure modernization. These include clarifying the program application criteria to encourage loan guarantee funding for energy infrastructure projects, increasing the leveraging effect of DOE loans and loan guarantees by encouraging broad-based public private partnerships, and improving the application process to eliminate the current backlog, cap administrative fees and enable the process to be more applicant-driven.

Title XVII Innovative Technology Program: EPACT (2005) requires that projects eligible for loan guarantees employ innovative technology. The statute describes categories of eligible technologies and allows DOE flexibility for making the determination of what constitutes innovative technology. Eligibility criteria are then further delineated in the LPO regulations. The regulatory requirements could be modified to support innovation in energy infrastructure in several ways, including:

- Clarifying that an innovative technology can consist of a *system of technologies* that can combine existing technologies in an innovative manner. This could enable eligibility for example, of smart transportation systems that combine state-of-the-art technologies for sensors, big data analytics and artificial intelligence in new and innovative ways;
- Clarifying that an innovative technology can include projects that incorporate new and innovative *platform technologies* developed outside the energy sector that enable *modernization of existing energy infrastructure and systems*. This could include, for example, smart sensors and controls that enable automation of electricity distribution systems, microgrids, and the integration of large-scale distributed energy resources (DER) and behind-the-meter applications such as the Internet of Things (IOT);
- Clarifying that an innovative technology can consist of innovations in software as well as hardware, enabling *innovative approaches for addressing cybersecurity*;
- Clarifying that innovative approaches to making existing energy infrastructure *more resilient* also qualify; and
- Allowing eligibility for water resources infrastructure projects that incorporate innovative technologies and systems approaches for addressing the energy-water nexus.

The criteria for project eligibility should also reflect regional variation. Energy systems and markets in the U.S. are inherently regional. The geographic reach of electricity networks, for example, is limited by the difficulty of efficiently moving electricity efficiently over long distances, and by physical boundaries such as oceans and mountains that limit the build-out of infrastructure.

Also, the current criteria limit Title XVII assistance to no more than three projects employing a similar innovative technology, which may not adequately account for regional variation in deployment circumstances. While the concept of a learning curve is an appropriate basis for restricting the number of eligible projects employing the same technology, the current three project restriction could be modified to be more responsive to regional variation. For example, the restriction could be modified to a national cap of 5 or 6 projects of similar technology with no more than two in any single region of the country. This would achieve a better

programmatic balance among the competing needs of demonstrating learning, allowing for regional variation and ensuring that limited loan authority supports a broad portfolio of technologies.

ATVM Program: EISA (2007) requires that ATVM loans be provided for manufacturing facilities that produce advanced technology light duty autos and trucks, as well as manufacturing facilities for qualifying components for advanced technology light duty autos and trucks. EISA, including subsequent amendments, establishes criteria for determination of advanced technology based on fuel economy and emissions characteristics.

The program eligibility requirements were clarified in January 2017 to include *manufacturing of fueling infrastructure equipment for advanced technology vehicles*. This could cover, for example, manufacturing of equipment for electric vehicle charging stations, hydrogen fuel distribution equipment and manufacturing of equipment for methanol, compressed natural gas (CNG), liquefied natural gas (LNG) and other alternative fuel systems. DOE previously addressed eligibility of electric vehicle battery charging systems and other alternative vehicle fueling infrastructure in the Title XVII loan guarantee program, serving as a first step toward addressing alternative vehicle fueling infrastructure. A related issue is whether the current EISA eligibility standard could be interpreted to include *financing of fueling system deployment costs as well as equipment manufacturing.*

The current scope of the program could be even more supportive of infrastructure modernization by expanding the definition of advanced technology vehicles to include *medium and heavy-duty trucks and buses.* This would be especially beneficial for commercial trucking applications where any increase in capital costs must meet stringent criteria for payback periods. Infrastructure for autonomous heavy-duty trucks is generating considerable interest and could be supported as a very innovative initiative. Medium-duty short haul trucking fleets represent a prime opportunity for near term electrification. It also would be critical to support manufacturing of advanced technology buses that support smart cities initiatives. These changes would require legislative amendment to the basic ATVM authorities in EISA.

Finally, it should be noted that there also have been proposals to expand eligibility under ATVM to other modes of transportation, such as water and marine vessels. Inland waterways and numerous ports play a major role in the energy supply chain.

Indian Energy Loan Guarantee Program: EPACT (2005) provides broad flexibility to DOE for both project eligibility as well as terms and conditions. The statute refers to eligible activities to include "energy development" as well as expanded provision of electricity on Indian lands. This authorization can be interpreted to include a broad set of energy-related infrastructure projects. The key issue is for DOE to proceed to develop and issue regulations to implement the program.

Increasing the Scale of Leveraging by Encouraging Expanded Public Private Partnerships. EPACT authorizes loan guarantees of up to 80 percent of total project costs; i.e. a minimum of 20 percent equity investment is required. The current Title XVII loan guarantee portfolio has achieved much greater leveraging – the current $30 billion loan guarantee portfolio has

leveraged $50 billion in total project value – drawing 40 percent equity participation by the private sector. Further leveraging of DOE loan and loan guarantee authority can be achieved by using DOE creditworthiness underwriting standards to attract increased co-lending from the private sector, states and other federal credit programs, without necessarily increasing private equity requirements. Specific approaches include:

Drawing Private Sector Lenders into the Program. Currently, the entire Title XVII loan guarantee portfolio has been implemented through loans made by the Federal Financing Bank (FFB). DOE sought to include private lenders in the program through the Financial Institution Partnership Program (FIPP). DOE should examine other approaches to encourage broader participation of private lenders in the program in a manner that can be accomplished without abrogation of the federal government's first lien position in project assets. The track record of LPO should make co-lending more attractive for a new tranche of loans and loan guarantees, particularly with progress in reducing transaction costs. Co-lending would enable the combination to leverage increased total project investments without increasing private equity contributions.

Support for State Financing Programs. Several states have programs to assist in the financing of energy technology deployment and energy infrastructures. These programs include State Green Banks as well as economic development assistance programs. LPO could make available a share of its credit authority to backstop state energy financing programs. LPO could backstop these activities by providing credit support to supplement state financings for a portfolio of projects for modernizing energy infrastructures through the application of innovative technologies and systems management approaches.

Integration with Other Federal Credit Programs. There are other federal agency credit programs that can provide credit support to projects that incorporate innovative energy technologies, including, but not limited to:

- The Transportation Infrastructure Finance and Innovation Act (TIFIA) program of loans, loan guarantees and lines of credit to state and local governments administered by the Department of Transportation (DOT);
- The Rural Utilities Service (RUS) Rural Electrification and Telecommunications Loan Program administered by the Department of Agriculture (USDA);
- The RUS Rural Water and Wastewater loan program also in USDA;
- The Water Infrastructure Finance and Innovation Act (WIFIA) loan program administered by the Environmental Protection Agency (EPA);
- The Clean Water State Revolving Fund and Drinking Water State Revolving Fund programs administered by EPA; and
- The Maritime Title XI Loan Guarantee Program in DOT.

Combining or coordinating DOE Title XVII loan guarantee assistance with credit support from these other projects can increase the leverage effects of the combined programs. For example, WIFIA loans have leveraged total investments more than twice as large as the loan amount.

Achieving integration, however, will be challenging. Each program has different authorizations, funding requirements and oversight from different Cabinet Secretaries, OMB staff offices and Congressional committees. Nevertheless, administrative efforts to improve coordination and integration, utilizing existing budgetary resources, could achieve faster results than establishing a new, clean sheet credit assistance program. Better coordination and utilization of existing federal credit authorities (all of which have existing budgetary resources) should be a central element of any new government-wide infrastructure modernization program initiative. An initial effort could focus on coordination of the DOE Title XVII program with one other agency, such as the Rural Utilities Service loan programs.

Broadening the networking of the Title XVII program with both other federal credit programs, states and private sector lenders could realistically increase the leveraging of the Title XVII loan guarantee portfolio, so that DOE credit support would constitute less than 50 percent of total project investment. If, for example, every dollar of DOE credit authority could lever $1.50 or more of a combination of other federal credit support, state and local government support and private sector investment, the current estimated remaining $39 billion of DOE credit authority could leverage a total of $100 billion of new investment in innovative energy technologies and associated infrastructure.

Pathways for Improving the Application Process (without Diminishing Substantive Credit Underwriting Requirements). There are several process improvements that could aid the DOE loan programs in supporting innovative infrastructure projects. These include capping administrative costs, addressing the backlog of projects, and enabling an applicant driven process.

Adjusting Administrative Costs. The current rigorous application process has a relatively high transaction cost in terms of both money and time. It is a stage-gated process, with increasing requirements leading to a conditional commitment. The conditional commitments themselves typically include many of conditions precedent, or pre-closing requirements. In the Title XVII program, the applicant is responsible for the entire cost of the application and underwriting process; in the ATVM program, administrative costs to the applicant are capped at the higher of $100,000 or 10 basis points of the loan.

DOE should consider ways to adjust applicant costs under the Title XVII program. One possible approach would be to re-shape the schedule of applicant fees leading up to a conditional commitment, with full cost recovery achieved at the stage of the final loan guarantee commitment. This would make applicant costs more manageable during the early stages of the application process, with the government ultimately achieving full cost recovery from successful applicants. The FY 2019 budget indicates that LPO had a surplus balance of $24 million of fees at the beginning of FY 2018, providing some financial flexibility to re-shape the fee structure.

Addressing the Backlog of Current Applications. As of December 2016, DOE reported 70 applications pending in the loan program. Since that snapshot in time, it is not known how many additional applications have been filed, how many applications may have been declined,

or how many applications may have been withdrawn. Over the past year, only one new loan guarantee conditional commitment has been made.

As part of the effort to emphasize opportunities for funding innovative energy infrastructure, the current backlog of applications must be addressed. Setting a reasonable and transparent schedule, commensurate with time periods in private sector banking, should enable LPO to make final decisions on these applications. This should not prejudge the outcome, nor should it be viewed as an alternative to amending the program to support a broader scope of innovative energy infrastructure projects.

Enabling an Applicant-driven Application Process. Re-defining project eligibility criteria to focus on innovative energy infrastructure projects should be accompanied by a change in the application process. For the Title XVII program, DOE accepts applications only in response to formal DOE solicitations, which historically have been technology-specific. While DOE has moved to keep past solicitations open, allowing for windows of opportunity for applications to be submitted, the process is too highly constrained; it is modeled after a government procurement process where the government sets the requirements and schedule rather than a banking process where the financing institution responds to applications whose scope and schedule are self-determined.

As part of the process of re-defining project eligibility criteria, DOE should replace the current technology stovepipe solicitations with a general open solicitation and enable private sector applicants to respond to changing market conditions to bring forward viable proposals to meet market needs. Greater reliance on project sponsors to plan and schedule projects also should enable more opportunities to form partnerships, including partnering with other governmental financial assistance programs.

DOE also should seek an amendment to the technology-specific constraints on the use of its existing Title XVII loan authority to allow flexibility for the market – rather than the government – to determine the innovative technology priorities, while remaining consistent with the statutory program objective to advance clean energy deployment. If the number of eligible and feasible project applications exceed the amount of credit authority currently available within a technology area, DOE should exercise its administrative flexibility to reallocate the $ 4 billion of non-earmarked loan guarantee authority to encourage a balanced portfolio of clean energy projects selected for assistance.

Conclusion: Leveraging the DOE Loan Programs to Help Modernize the Nation's Energy Infrastructure

The DOE LPO is an important and relevant program that is critical for maintaining the U.S. edge in global technology innovation. On multiple levels, the Title XVII and ATVM programs have succeeded in accelerating energy innovation, which has resulted in significant economic, environmental, and social benefits. With an additional $39 billion in available loan authority, these programs are ready to support future investments in energy and transportation infrastructure.

Congress should build upon the success of these programs to expand their efforts in response to the President's call for increased investment in U.S. infrastructure. As a proven enabler of public-private partnerships that advance innovation in the U.S. energy and transportation sectors, these programs could be major platforms for deploying more private sector capital in critical energy and transportation projects. It bears repeating: estimates suggest that using the currently available authority, the LPO could leverage up to $100 billion of investments to support innovation and infrastructure modernization across the entire energy sector.

Estimates suggest that by using the $39 billion in currently available authority, DOE's loan programs could leverage up to $100 billion of investments to support innovation and infrastructure modernization across the entire energy sector.

ENERGY FUTURES INITIATIVE

End Notes

[1] Department of Homeland Security website, accessed 02/14/18
[2] https://energy.gov/lpo/title-xvii
[3] https://energy.gov/lpo/title-xvii/title-xvii-project-eligibility
[4] https://energy.gov/lpo/title-xvii
[5] https://energy.gov/sites/prod/files/2015/02/f19/DOE_LPO_Utility-Scale_PV_Solar_Markets_February2015.pdf
[6] https://energy.gov/sites/prod/files/2015/02/f19/DOE_LPO_Utility-Scale_PV_Solar_Markets_February2015.pdf
[7] https://energy.gov/sites/prod/files/2015/02/f19/DOE_LPO_Utility-Scale_PV_Solar_Markets_February2015.pdf
[8] https://energy.gov/lpo/articles/mesquite-solar-highlights-how-doe-loan-guarantees-helped-launch-utility-scale-pv-solar
[9] https://www.eia.gov/electricity/annual/archieve/03482015.pdf
[10] https://energy.gov/sites/prod/files/2015/02/f19/DOE_LPO_Utility-Scale_PV_Solar_Markets_February2015.pdf
[11] https://www.nrdc.org/experts/amanda-levin/doe-program-propels-thriving-clean-energy-economy-industries
[12] https://energy.gov/lpo/title-xvii
[13] http://www.pewtrusts.org/~/media/assets/2015/02/doe_loan_program_fact_sheet_final.pdf
[14] https://energy.gov/lpo/atvm
[15] https://energy.gov/lpo/atvm
[16] https://energy.gov/sites/prod/files/2016/02/f29/DOE-LPO_Mini-Reports_004_ATVM-Driving-Economic-Growth_FINAL_Jan-2016.pdf
[17] https://energy.gov/sites/prod/files/2016/02/f29/DOE-LPO_Mini-Reports_004_ATVM-Driving-Economic-Growth_FINAL_Jan-2016.pdf
[18] https://energy.gov/lpo/ford
[19] https://energy.gov/sites/prod/files/2016/02/f29/DOE-LPO_Mini-Reports_004_ATVM-Driving-Economic-Growth_FINAL_Jan-2016.pdf
[20] https://energy.gov/lpo/tesla
[21] https://electrek.co/2016/11/25/tesla-30000-employees-solarcity/
[22] https://energy.gov/lpo/tesla
[23] https://energy.gov/lpo/nissan
[24] https://energy.gov/lpo/nissan
[25] https://energy.gov/lpo/portfolio/portfolio-management
[26] http://www.gao.gov/assets/680/675595.pdf
[27] http://www.gao.gov/assets/590/589210.pdf
[28] http://www.gao.gov/assets/680/675595.pdf
[29] http://www.gao.gov/assets/680/675595.pdf
[30] https://energy.gov/lpo/portfolio
[31] https://www.nrdc.org/experts/amanda-levin/doe-program-propels-thriving-clean-energy-economy-industries
[32] https://www.nrdc.org/experts/amanda-levin/doe-program-propels-thriving-clean-energy-economy-industries
[33] http://fortune.com/2017/08/04/department-of-energy-40th-anniversary-rick-perry/
[34] https://energy.gov/sites/prod/files/styles/borealis_photo_gallery_large_respondlarge/public/2017/07/f35/LPO-PortfolioPerfSummary-Chart-2017-07.png?itok=TW6xTBcG.
[35] http://www.reuters.com/article/us-doe-loans-idUSKCN0IX0A120141113
[36] http://www.slate.com/articles/business/the_juice/2015/06/peter_davidson_steps_down_from_energy_department_his_loan_program_was_responsible.html
[37] https://energy.gov/lpo/about-us-home
[38] https://energy.gov/lpo/about-us-home. The remaining loan authority for the Advanced Fossil solicitation reflects a reduction of $2 billion for the Lake Charles, LLC project.
[39] https://energy.gov/articles/energy-department-offers-conditional-commitment-first-advanced-fossil-energy-loan-guarantee
[40] http://docs.house.gov/meetings/IF/IF03/20180109/106757/HHRG-115-IF03-20180109-SD006.pdf
[41] https://phys.org/news/2018-01-appalachia-underground-natural-gas-storage.html; https://insiderfinancial.com/its-make-or-break-for-glori-energy-inc-nasdaqglri; http://owossoindependent.com/new-steel-international-identified-project-tim-developer/; http://newsroom.nuscalepower.com/press-release/nuscale-power-llc-submits-part-ii-doe-loan-guarantee-application; https://www.utilitydive.com/news/beyond-batteries-the-diverse-technologies-vying-for-the-bulk-storage-marke/405189/; http://www.sundropfuels.com/About%20Us/about; https://www.delawareonline.com/story/money/small-business/2016/08/14/delawares-white-dog-labs-pioneers-new-biochemical-technology/88715126/
[42] https://energy.gov/articles/energy-department-offers-conditional-commitment-first-advanced-fossil-energy-loan-guarantee
[43] https://energy.gov/articles/energy-department-offers-conditional-commitment-first-advanced-fossil-energy-loan-guarantee
[44] http://neori.org/u-s-budget-bill-includes-landmark-carbon-capture-tax-credit-to-benefit-economy-jobs-and-the-environment/
[45] ttps://energy.gov/articles/secretary-perry-announces-conditional-commitment-support-continued-construction-vogtle
[46] https://www.energy.gov/sites/prod/files/2015/07/f24/QER%20Full%20Report_TS%26D%20April%202015_0.pdf
[47] https://www.infrastructurereportcard.org/wp-content/uploads/2017/01/Energy-Final.pdf
[48] http://www.infrastructurereportcard.org/wp-content/uploads/2017/01/Energy-Final.pdf
[49] https://www.smartgrid.gov/files/Estimating_Costs_Benefits_Smart_Grid_Preliminary_Estimate_In_201103.pdf
[50] http://www.infrastructurereportcard.org/wp-content/uploads/2017/01/Energy-Final.pdf
[51] https://www.energy.gov/sites/prod/files/2015/07/f24/QER%20Full%20Report_TS%26D%20April%202015_0.pdf
[52] http://playbook.aga.org/mobile/index.html#p=33

[53] http://www.api.org/~/media/Files/Policy/Infrastructure/API-Infrastructure-Study-2017.pdf
[54] http://www.infrastructurereportcard.org/wp-content/uploads/2016/05/2016-FTA-Report-Close-the-Gap.pdf
[55] http://www.infrastructurereportcard.org/wp-content/uploads/2016/05/2016-FTA-Report-Close-the-Gap.pdf
[56] Solar Energy Industry Association (SEIA) data, American Wind Energy Association (AWEA) data
[57] https://www.eia.gov/electricity/monthly/ as of October 2017
[58] https://www.pwc.com/gx/en/issues/technology/tech-breakthroughs-megatrend.html
[59] https://energy.gov/sites/prod/files/2016/11/f34/Distribution%20Automation%20Summary%20Report_09-29-16.pdf
[60] http://www.powersystem.org/substation-automation
[61] IEA investment
[62] https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf
[63] https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf
[64] https://www.census.gov
[65] https://cfpub.epa.gov/roe/indicator.cfm?i=52#1
[66] https://census.gov/newsroom/press-releases/2016/cb16-214.html
[67] https://www.census.gov/data/tables/2014/demo/popproj/2014-summary-tables.html
[68] https://cfpub.epa.gov/roe/indicator.cfm?i=52#1
[69] https://www.census.gov/newsroom/releases/archives/2010_census/cb12-50.html
[70] https://www.census.gov/newsroom/press-releases/2016/cb16-210.html
[71] https://census.gov/newsroom/press-releases/2016/cb16-214.html
[72] http://www.noaanews.noaa.gov/stories2013/20130325_coastalpopulation.html
[73] https://www.ieee.org/publications_standards/publications/periodicals/ieee-smart-cities-trend-paper-2017.pdf
[74] https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf
[75] https://energy.gov/sites/prod/files/2017/02/f34/Quadrennial%20Energy%20Review--Second%20Installment%20%28Full%20Report%29.pdf

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