Written Statement of Ms. Jetta Wong
Hearing on "From Lab to Market: Accelerating our Progress toward Economic Recovery and a Clean Energy Future"
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Introduction

Chairwoman Fletcher, Ranking Member Weber, and Members of the Subcommittee, I appreciate the opportunity to appear before you today to testify on technology transfer and commercialization at the U.S. Department of Energy and for the potential for these activities to contribute to economic recovery from the current COVID-19 pandemic. As you know, I was the first Director of the Office of Technology Transitions and served at DOE from 2012 through January of 2017.

It is particularly an honor for me to be here, before this subcommittee, because I was a staffer on this subcommittee before working for DOE. It is wonderful to see familiar faces and to be able to contribute to the great body of work that this committee has put forward over the last several decades to strengthen our economy through science, technology, and innovation policy. Thank you for this opportunity.

The Problem

Over the coming decades, the world economy must make a transition to low-carbon and no-carbon energy. This transition will require accelerated innovation to affordably reduce the carbon footprint of all major emissions sources, including hard-to-decarbonize sectors such as long-distance transportation and manufacturing, as well as electricity and light-duty vehicles where the transition has already begun.

The United States' strong support for energy research and development should position it well to lead the global energy transition. But the United States has difficulty moving new technologies from early discovery to scale. No one entity in the U.S. energy innovation system is responsible for bringing new technologies across the fabled "valley of death" between proof of concept and early adoption in the market. Government and philanthropic funding typically come too early in the process to help would-be innovators get to market, while the private sector (with a few exceptions) prefers investments that pay off more quickly and with more certainty. The same thing can be said for many technologies derived from hard science, including the development of vaccines and new medicines.

This gap in the nation's energy innovation system could put the climate at risk by stalling the transition. It could also open the way for China and other countries to capitalize on U.S. investments. If key technologies are made overseas, the United States will lose out on many of the commercial opportunities the transition will create and its national security could be compromised. If the United States is to lead the world toward a cleaner energy future and gain the economic, security, and environmental benefits of that leadership, it must fill the gaps in its system for commercializing new energy technologies by better connecting the diverse players that make up the innovation ecosystem. Some of the same policies, strategies, programs, and activities that will close the innovation gap for energy can facilitate the commercialization of health technologies as well.

The need for a concerted effort to resource and prioritize the commercialization of new energy technology is urgent. The United States, in spite of its scientific prowess, is not making rapid enough progress toward solving the diverse and difficult decarbonization challenges it faces. The bills we will discuss today will not solve all that ails the U.S. energy innovation system. But they will help DOE to lower the mortality rate of innovators seeking to cross the valley of death and encourage other actors to take actions that would have that effect as well.

My testimony will cover the value of federal laboratories to the economic recovery from COVID-19, some of the main issues related to DOE technology transfer and commercialization which relate to all technology developed at DOE, will provide a high-level overview of how DOE has addressed these issues, and then describe some of the areas which still need assistance. These issues include:

1. Resourcing and prioritizing technology transfer and commercialization;
2. Strengthening demand or "user" pull throughout the innovation process; and
3. Piloting, evaluating, and then scaling good ideas.

I will then briefly examine the Energizing Technology Transfer Act discussion draft and then provide a brief vision and summary of a Department of Energy foundation, similar to the foundation authorized in the Increasing and Mobilizing Partnerships to Achieve Commercialization of Technologies for Energy Act or IMPACT Act (HR 3575).

Federal Laboratories' Contributions to Economic Recovery

Many individuals attribute contributions from the U.S. federal laboratory system to investments made during World War II, but this science and technology infrastructure dates back to the mid-1800s with the establishment of the Smithsonian Institute in 1846 followed by the creation of Agriculture Research Service of the Department of Agriculture in 1862. These early investments, and others, in research and development to understand the world around us brought new technology and practices that shaped the way humans provided food for themselves, communicated, and preserved life through new advances in medicine. Now the federal laboratory infrastructure in the U.S. is made up of over 300 laboratories covering all aspects of science and technology which contribute to a growing innovation economy.

Most recently, federal laboratories have been at the forefront in the fight against COVID-19. New intiatives have provided the country with new medicines, technologies, research, and supercomputing capabilities focused on helping scientists understand and diagnose, and find a treatment for the disease, and eventually develop a vaccine.[1] These kinds of investments not only save lives but provide significant economic benefit to the country. According to a Battelle Institute study from 2013, the total economic impact of close to $1 trillion investment in the Human Genome Project (HGP) since 1988, has provided a 178:1 return on investment.[2] The HGP was led by a collaboration between the National Institutes for Health and the Department of Energy. Ultimately, this collaboration provided the tools and framework for numerous partners to access the data and to collaborate on the development of human medicine, therapies, diagnostics, and other technologies that improve our quality of life.

[1] DOE Laboratories are part of the COVID-19 High Performance Computing Consortium providing supercomputing systems to researchers to address the epidemiology, bioinformatics and molecular modeling of COVID-19. https://covid19-hpc-consotrium.org.

[2] The Impact of Genomics on the U.S. Economy, Battelle Technology Partnership Practice for United for Medical Research (June 2013).

DOE's national laboratories have already led the way in scientific discoveries related solar power, battery technology, fuel cell technology, LED light bulbs, and dozens of other energy technologies changing the way we use electricity and transport people and goods. They have also strengthened our country's ability to protect critical infrastructure from cyber security threats and ultimately secure the world from nuclear war. Furthering these science-driven solutions to address our most technological challenges will prove to lift the country up through the establishment of new innovative companies, reduced energy prices, and increased climate resilience. Early breakthroughs and commercial successes facilitated by DOE's national labs can be attributed to the interdisciplinary structure of the labs, their ability to interact with multi-partners, and their ability to scale technologies for national security needs through internal and external partnerships. This is not new for DOE.

DOE Technology Transfer and Commercialization

The DOE and its national labs collaborate on science and technology that will benefit humanity. This has been the case since the beginning with Ernest Lawrence, the first laboratory director of Lawrence Berkeley National Laboratory, who structured his research around interdisciplinary collaborative science. Whether it was his legendary work with J. Robert Oppenheimer, or Lawrence's work to fund the development of the world's first cyclotron, he worked through collaboration on scientific problems. R&D conducted by DOE and its predecessors have had strong collaborative ties among scientists and with outside philanthropic and private sector partners.

Collaboration is important because it is the key to technology transfer and commercialization. Technology transfer, defined in 2011 by former DOE Secretary Steven Chu is "the process by which knowledge, intellectual property or capabilities developed at the DOE's national laboratories, single-purpose research facilities, plants, and other facilities are transferred to other entities, including private industry, academia, state or local governments."[3] When DOE established the Office of Technology Transitions in 2015, it examined the office's role within the Department, it came up with a wider remit for its efforts. The statutory DOE Technology Transfer Execution Plan released in 2016 states, "The OTT has been established not to simply guide singular acts of technology transfer, but rather to foster multiple handoffs between scientists and innovators and investors that make up the dynamic process of technology transitions and nurture the Nation's innovation ecosystem."[4] The "handoffs" and the "dynamic process" occurs through collaboration of a diversity of players, both inside and outside the government.

Overtime, the flexibility, structures, and incentives at DOE that lead to historic collaborations have changed, some through legislation, others through norms and practices codified in DOE orders and directives. The passage of the Stevenson-Wydler Technology Innovation Act of 1980, was one of the first actions taken by Congress to legislate that new discoveries and advances in science should be transferred and utilized to nonfederal entities for societal goals. This act, followed by more than a dozen other laws and executive orders govern technology transfer and commercialization of all federally funded R&D and often creates incentives for increased collaboration. In addition, Congress has shown a

[3] *Secretarial Policy Statement on Technology Transfer at DOE Facilities*, The Honorable Steven Chu, Secretary, Department of Energy, 2011 http://energy.gov/sites/prod/files/gcprod/documents/Policy_Statement_on_TT.pdf.
[4] Technology Transfer Execution Plan, Office of Technology Transitions, Department of Energy, 2016 https://www.energy.gov/sites/prod/files/2016/10/f33/TTEP%20Final.pdf.

particular interest in these activities at DOE with addition authorities provided in the Energy Policy Act of 2005, and most recently in the Department of Energy Research and Innovation Act of 2018, led by the actions of this Committee[5]. These laws authorize multiple collaboration pathways for the transfer and use of DOE funded R&D through minimal tweaks to mostly existing policies and programs.

While it appears this strong interest from Congress would make this a priority for DOE, the actions of DOE and multiple reports over the last few decades demonstrate otherwise. Institutional barriers, misaligned structures, and weak incentives for federally funded researchers lead to significant commercialization shortfalls and hinder the United States from leading the global clean energy transition.[6]

DOE has been whipsawed and hamstrung by political forces beyond its control, making it more risk-averse and cumbersome than most other agencies. The Secretary of Energy Advisory Board found in a 2015 study:

> The lack of consistent and sustained expectations by the DOE for engagement with industry by the laboratories has driven inconsistent focus on industry engagement by laboratory management. Many laboratory directors noted the cyclical nature of DOE expectations regarding industry engagement and the uncertainty regarding industry engagement as part of the DOE mission.[7]

This inconsistency, which has gone on for decades, has created a risk-averse environment within the national labs and the department. Decision-makers sometimes choose to take no action on technology transfer, even when mandated by Congress, because they fear the political winds might change at any time.[8] The popular Technology Commercialization Fund, for instance, was mandated by Congress in 2005, but not set up for another 10 years.[9]

That said, DOE has been going through a process of reform, and Congress, specifically this committee, has been one of the instigators in this process. Some would argue that in 2005 Congress helped kick this process off with the statutory creation of a Technology Transfer Coordinator and the creation of the TCF. One could also argue that Congress' creation of ARPA-E in 2007 was also a way to reform DOE. Further evolutions in the way DOE conducts research include the establishment of energy frontier research centers in 2009, and the creation of innovation hubs in 2010. Most recently the Office of

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[5] Federal Lab Consortium, "Federal Technology Transfer Legislation and Policy: The Green Book" (Federal Lab Consortium, 2018), https://www.federallabs.org/download/file/fid/34317.

[6] Secretary of Energy Advisory Board, "Interim Report," 28; Stepp et al., "Turning the Page;" U.S. Department of Energy Office of Inspector General, "Audit Report: Technology Transfer and Commercialization Efforts at the Department of Energy's National Laboratories (Washington, D.C.: DOE, 2014), 2; U.S. Government Accountability Office, "Clearer Priorities and Greater Use of Innovative Approaches Could Increase the Effectiveness of Energy Laboratories," (Washington, D.C. GAO, 2009), 1.

[7] Secretary of Energy Advisory Board, "Interim Report of the Task Force on DOE National Labs," (Washington, D.C., SEAB, June 2015), 29, https://www.energy.gov/seab/downloads/interim-report-task-force-doe-national-laboratories.

[8] IHS Markit and Energy Futures Initiative, Advancing the Landscape of Clean Energy Innovation, February 2019, 134, https://www.b-t.energy/reports/advancing-the-landscape/.

[9] Commission to Review the Effectiveness of the National Energy Laboratories (CRENEL), Securing America's Future, 2015, 62, https://www.energy.gov/labcommission/downloads/final-report-commission-review-effectiveness-national-energy-laboratories.

Technology Transitions in 2015 was established to implement the vision behind the Technology Transfer Coordinator and the Technology Commercialization Fund. The efforts of the previous administration, and the efforts of the current administration to improve OTT and build it into an integral part of the department can be enhanced and strengthen by the two pieces of legislation we will discuss today.

Additional Efforts are Still Needed

While significant, the current activities of DOE and OTT, in particular, do not negate the overwhelming cultural and programmatic bias of the agency toward early-stage discovery science. Areas for improvement were outlined in the first Technology Transfer Execution Plan released in October of 2016. This plan outlined two critical goals for technology transition efforts of the department. The two goals included:

> Goal 1: Increase the commercial impact of DOE investments through the transition of national laboratory-developed technologies into the private sector.
>
> Goal 2: Increase the commercial impact of DOE investments through private sector utilization of national laboratory facilities and expertise.

Since then, DOE has launch programs with these two goals in mind. Yet, some of the objectives and key activities, also outlined in the report, have yet to be realized. I will examine the two bills for discussion with these goals and the following three additional elements, in mind.

Resource and Prioritize

If Congress wants to increase technology transfer and commercialization at the Department of Energy it needs to resource and prioritize it. When DOE launched OTT and asked the national labs how it could improve technology transitions, it heard very clearly that technology transfer and commercialization are not a high priority for most of the labs and if DOE wanted to see the labs assist in the commercialization of new technology then DOE would need to provide funds for those activities. All DOE lab activities must be billed to a specific budget line. DOE labs currently fund technology transfer out of their indirect budget lines. This means that the statutory technology transfer offices of each laboratory are competing with other items in the indirect budgets of the lab, that includes security and some infrastructure improvements, among other things. Congress needs to fund technology transfer activities that are not accounted for through the indirect budgets of the laboratories.

Furthermore, DOE uses Performance Evaluation and Measurement Plans (PEMPs) to achieve specific outcomes, but they often lack specific commercialization outcomes and inadvertently discourage technology transfer.[10] To help prioritize technology transfer at the labs this process needs to more effectively include these activities as a primary mission of each national laboratory. Congress needs to further instruct DOE to prioritize these activities in laboratory and individual scientist's performance plans.

[10] Matthew Stepp et al., "Turning the Page: Reimagining the National Labs in the 21st Century Innovation Economy" (ITIF, Center for American Progress, and Heritage Foundation, 2013), 48, https://itif.org/publications/2013/06/19/turning-page-reimagining-national-labs-21st-century-innovation-economy.

Demand or "User" Pull Through the Full Innovation Process

The road from basic research to the market for new products and services is often long, complicated, and beset by significant barriers. A model of the innovation process set out by the President's Council of Advisors on Science and Technology describes four interrelated stages: invention, translation, adoption, and diffusion. Programs and policies across these stages shape a complicated innovation ecosystem that includes a diverse network of institutions. Few technologies move from research to market in a linear fashion. Most are aided by feedbacks from later stages to earlier ones, so that downstream learning is incorporated into design and development.[11]

When these feedback loops break down and the major players are disconnected, promising technologies fall into the valley of death. The Energy Futures Initiative (EFI) and IHS Markit report on energy innovation released last year notes that success in crossing the valley of death "requires the alignment of many players," who bring different skills, experiences, knowledge, and resources to the innovation process.[12]

Unfortunately, most laboratory and academic researchers do not have the tools or the skill sets to bring their ideas to commercialization. Furthermore, DOE's "supply-push" mentality does not enable engagement with the private sector, which is needed to commercialize new technology. When research is informed by private sector demands, the private sector will be more interested and willing to bring new technologies to the market. In short, the players in the United States are often not aligned and DOE's bureaucratic and largely basic science focused infrastructure does not have effective nor systematic ways to incorporate the feedback loops from the myriad of private sector players needed to take technologies to the market.

Pilot, Evaluate, and Scale Good Ideas

Given that DOE is risk-averse it should be funded to experiment with new pathways to commercialization. The Secretary of Energy Advisory Board's (SEAB) National Laboratory Task Force made several suggestions on programs to pilot. Some of these recommendations, such as the development of a fast-track Cooperative and Research and Development Agreement (CRADA) have been experimented with by different labs. Yet, while DOE has made significant strides in recent years to pilot programs and better fulfill its commercialization mandate through these pilots, it lacks the data to demonstrate if these activities have been successful in facilitating either of the stated goals from the TTEP. Furthermore, since there is little data on these programs it is difficult to know whether these programs should be scaled.

The federal agencies, including DOE, collect and report technology transfer activities to Congress on a regular basis. Examinations of technology transfer at DOE have repeatedly found that the department lacks a strategic approach, metrics and evaluation criteria, and appropriate policies to improve its performance in commercializing new technologies. A 2015 report by the Secretary of Energy Advisory Board estimated "that universities create 5 to 8 times more start-up companies on a research-adjusted

[11] Executive Office of the President, President's Council of Advisors on Science and Technology (PCAST), Report to the President on Accelerating the Pace of Change in Energy Technologies Through an Integrated Federal Energy Policy (Washington, D.C.: The White House, November 2010), 4, https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/pcast-energy-tech-report.pdf.

[12] IHS Markit and Energy Futures Initiative, Advancing the Landscape of Clean Energy Innovation, February 2019, 37, https://www.b-t.energy/reports/advancing-the-landscape/.

basis than the DOE national laboratories." Unfortunately, DOE lacks the granular data needed to understand and improve the impact of individual programs or individual laboratories to facilitate the creation of more start-ups.

DOE needs to institute a policy of piloting, evaluating, and then scaling innovative ideas. Rigorous evaluation over an extended period is required because, as we know from the innovation process, commercialization may take several years. Only two of the programs initiated by DOE have had a third-party and peer reviewed evaluation of their impact: Energy I-Corps and Small Business Vouchers (discussed below).

Energizing Technology Transfer Act

With the two goals from the TTEP and the three high-level elements above in mind, I commend the Committee for the balanced and thoughtful programs and policies identified in the Energizing Technology Transfer Act discussion draft. It authorizes several programs that DOE has piloted and provides important direction and funding for those programs to be successful in facilitating the commercialization of new technology.

Energy I-Corps and Other Demand-Pull Programs (Goal 1)

The bill authorizes several programs that will incorporate more demand pull into the R&D activities of DOE and its labs. The Department's Energy I-Corps program trains national lab researchers to become entrepreneurs, providing them the tools to engage and understand potential customers and perhaps spinout federally-funded technology to the market (goal 1). It has been evaluated by a third-party which found the program to be moving the labs in the right direction. For example, 95 percent of Energy I-Corps participants reported a better understanding of their technologies' value proposition and could identify key market decision-makers after completing the program. Additionally, 80 percent reported being likely to apply the learnings from the program to similar activities.[13] This program was created to increase the demand pull on technology developed by the national labs. Other programs in the discussion draft such as the Lab-Embedded Entrepreneurship Program, Regional Clean Energy Innovation Partnerships, and the National Clean Energy Incubator Program have strong ties to understanding the market and identifying partners that can inform technology development and customers that help facilitate the commercialization of new technology.

Small Business Vouchers and Lab Partnering Service (Goal 2)

Programs in the bill that focus on facilitating access to facilities and expertise (goal 2) of the DOE and its labs such as the Lab Partnering Service and the Small Buisness Voucher program will provide important opportunities for collaboration. SBV was a pilot program started in EERE which provided small businesses access to DOE national lab capabilities and was structured to make lab business practices more compatible with private-sector timelines. A third-party evaluation of the pilot found that 81 percent of awardees advanced at least one level on the technology readiness level scale compared with 43 percent of nonparticipants. Almost half of all awardees received follow-on funding, and 18 percent achieved sales of their SBV-related technology. Ninety-one percent of awardees rated positively how

[13] Gretchen Jordan and Albert Link, Second-year Evaluation of the U.S. Department of Energy I-Corps Program (Washington, D.C.: U.S. Department of Energy, March 2018), https://www.energy.gov/sites/prod/files/2018/12/f58/impact-eval-energy-icorp-03-2018.pdf.

quickly they were able to sign contracts with a national lab—a key goal of the pilot. The evaluation also found the pilot's central application portal was a key to its success, consolidating descriptions of lab resources and capabilities, simplifying the application process, and linking to the labs' standardized contracting mechanisms. This program has been transferred to the Office of Technology Transitions (OTT) and should be funded under one budget line to reduce overly complicated and restrictive technology silos of the department.[14]

The measures provided by the third-party evaluator demonstrate the value of SBV, the same can not be said about the Lab Partnering Service. This service was started by my team at OTT, and while we had strong interest in the tool from some labs and outside stakeholders, it is unclear what value it is providing these stakeholders. The bill requires an evaluation at three years, which seems appropriate. If the evaluation proves the tool to be unsuccessful in achieving its stated goals, it would be important for there to be a back-stop in the bill directing DOE to terminate or transitioned the tool to an entity outside of DOE that is more appropriate for managing and maintaining such a tool.

Technology Commercialization Fund

The new language for the Technology Commercialization Fund (TCF) mostly mirrors how the program is currently implemented by DOE. The original program had specific private sector matching requirements which the draft removes. Removing the matching requirement could be appropriate for early-stage technology from a national lab, but also removing the requirement for private sector engagement should be reconsidered. I encourage the committee to examine this language and ensure it brings in private sector partners to inform the development of lab technology and create the demand pull to enable commercialization.

Additionally, the draft bill does not fix one of the most vexing issues with the TCF. The TCF is created by cobbling together 0.9 percent of the applied energy R&D budgets of the department. That means that 0.9 percent of the solar, wind, water, fuel cell, etc. budgets are included in the TCF, but that does not mean the funds become one stream of funding. Instead, each 0.9 percent of a program office budget must still be used for the original technology it was appropriated for by Congress. This is often called the "color of money" issue. That means instead of having one $30 million fund every year, DOE implements a complicated, slow, and restrictive process for several budget lines to identify promising energy technologies for commercialization from the DOE labs. I recommend that the Committee amend the language to require that one fund be created with no restrictions to the kind of energy technologies the funds should be used to help commercialize.

Furthermore, it is not clear that the TCF has achieved its objective to facilitate the commercialization of new energy technology. It does not appear that DOE has evaluated the program. No data exists for the public to examine its performance and understand the value this program may be providing the labs or the country.

[14] Gretchen Jordan and Albert Link, Evaluation of U.S. DOE Small Business Vouchers Pilot (Washington, D.C.: DOE, November 2018), 37, https://www.energy.gov/sites/prod/files/2018/12/f58/eval-small-business-vouchers-pilot-112718.pdf. Gretchen Jordan and Albert Link, Second-year Evaluation of the U.S. Department of Energy I-Corps Program, (Washington, D.C.: U.S. Department of Energy, March 2018), https://www.energy.gov/sites/prod/files/2018/12/f58/impact-eval-energy-icorp-03-2018.pdf.

Resource and Prioritize
Finally, the discussion draft provides significant funds for many important commercialization programs. These funds will help support the under-resourced technology transfer offices at DOE labs, and will provide a cash infusion into struggling incubators and regional energy innovation intiatives. Non-profits, economic development organizations, and even universities, do not have the resources to assist in the commercialization of new technologies. Since these activities are often funded through indirect budgets or are an afterthought to R&D projects, in lean times when budgets are severally stressed, as we are seeing now with COVID-19, technology transfer and commercialization activities are the first things to be cut.

Additionally, the discussion draft creates a technology transitions program, to be implemented by the Technology Transfer Coordinator, or the Director of the Office of Technology Transitions. This section secures OTT's budget to conduct program activities, this is a clear message to DOE and the rest of Congress that OTT is a part of DOE's mission and not an administrative function to be funded out of overhead. This committee working with the appropriators should direct DOE to take OTT's budget line out of Department Administration and give it its own budget line.

The programs and policies of the discussion draft are admirable, and continued efforts should be made to develop these ideas to reform DOE, but in the highly competitive global innovation ecosystem, this is not enough. Like all federal agencies, DOE is constrained by important, but often complicated and bureaucratic processes that slow innovation.

Increasing & Mobilizing Partnerships to Achieve Commercialization of Technologies for Energy

More must be done to drive R&D from early-stage discovery projects to commercial products with social, environmental, and economic benefits for the country. The bipartisan and bicameral bill, Increasing and Mobilizing Partnerships to Achieve Commercialization of Technologies for Energy Act or IMPACT bill, directs the Secretary of Energy to create a not-for-profit energy foundation for the Department of Energy focused on the commercialization of new energy technology to achieve these benefits. In May of this year, I co-authored with David Hart of the Information Technology (ITIF) and Innovation Foundation a report called, *Mind the Gap: A design for a New Energy Technology Commercialization Foundation*, which lays out a vision, mission, and activities of such a foundation.

Discussions with key DOE and energy stakeholders suggested that decisions about a DOE foundation's organization and operation would have major implications for its effectiveness. Therefore, ITIF's goals for the report were:

1. To develop a better understanding of how a Department of Energy foundation should be organized and operated if it is to have the desired effect of improving and accelerating the commercialization of federally funded energy R&D.
2. To share this understanding with and build support, if appropriate, for it among key stakeholders in a future DOE foundation.

Below is a summary of the vision and design for a DOE foundation, which we call the Energy Technology Commercialization Foundation. It draws on more than 140 interviews and two full-day stakeholder

workshops, as well as extensive research on the diverse array of agency-related foundations Congress has authorized since 1967.

Energy Technology Commercialization Foundation Vision and Overview

A nonprofit Energy Technology Commercialization Foundation (ETCF), authorized by Congress to work closely with the U.S. Department of Energy (DOE), could help fill the valley of death by allowing energy innovators' access to DOE's tremendous technical expertise and world-class facilities, thereby helping them advance more quickly. It would encourage DOE-funded researchers to more aggressively seek commercial applications for their discoveries, and connect them with partners, funding, and tools to do so. These activities would be motivated by national and regional opportunities to develop globally scalable solutions to decarbonization challenges through collaborative partnerships with the private sector.

Within the context of these national and regional collaborative strategies, ETCF would regrant most of its funds, and direct its staff, advisors, and other resources to four commercialization activities. Most recipients of funding and resources, including DOE offices and labs, would:

1. streamline access to facilities and expertise;
2. educate and train researchers to become entrepreneurs;
3. carry out R&D to turn prototypes or other early-stage technologies into marketable products; and
4. convene energy innovation stakeholders.

ETCF would raise most of its funds from private-sector and philanthropic donors that see value in accelerating the commercialization of carbon reducing technologies. Groups of domestic companies seeking a competitive advantage in decarbonizing common activities or supply chains, for instance, would partner through ETCF to build up service providers and next-generation vendors. Mission- and region-oriented philanthropies would give to it to advance their environmental and economic objectives.

ETCF would regrant these funds to innovative teams and organizations developing new energy technologies in a variety of settings, including businesses, incubators, universities, and government laboratories. ETCF would leverage its strong connection to DOE to connect innovators with technical resources and expertise across the country, including DOE's 17 national laboratories and extensive network in academia and the private sector. ETCF's congressional authorization as envisioned in the ITIF report would allow it to catalyze technical collaborations more effectively than other nongovernmental entities. ETCF would complement and supplement DOE's own activities, doing what DOE is constrained by existing rules from doing or has proven unable to do with great success and speed.

ETCF would help DOE and energy innovation organizations respond more rapidly and effectively to cross-cutting challenges by convening private and philanthropic partners, developing strategies, and catalyzing collaborations focused on commercialization. These efforts would be driven by private-sector opportunities, and informed by DOE's depth of knowledge and expertise. They would cut-across several federal agencies, multiple units within DOE, and many state and local governments, along with a diverse array of private-sector interests. This will help overcome some of DOE's organizational and structural challenges with siloed funding, and management practices, while not duplicating DOE's activities and leveraging its expertise.

The ETCF's authorization would draw on precedents set by other congressionally authorized agency-related foundations, such as the National Park Foundation (NPF), the Foundation for the National Institutes of Health (FNIH), the Foundation for Food and Agriculture Research (FFAR), and the Centers for Disease Control Foundation (CDCF). These precedents include the capacity to create public-private partnerships in ways that federal agencies cannot, and the ability to transfer money and equipment to agencies. They can also take action more quickly and flexibly than agencies can, as exemplified by CDCF's ability to raise over $110 million to respond to COVID-19 so far in 2020.[15]

A 2019 Congressional Research Service report articulates several potential benefits of agency-related foundations for fostering public-private R&D collaborations:

1. providing a flexible and efficient mechanism for establishing public-private R&D partnerships;
2. enabling the solicitation, acceptance, and use of private donations to supplement work performed with federal R&D funds;
3. increasing technology transfer and the commercialization of federally funded R&D;
4. improving the ability of federal agencies to attract and retain scientific talent; and
5. enhancing public education and awareness regarding the role and value of federal R&D.

If the United States is to lead the world toward a cleaner energy future and gain the economic, security, and environmental benefits of that leadership, it must fill the gaps in its system for commercializing new energy technologies by better connecting the diverse players that make up the energy innovation ecosystem. Building on the flexible, challenge-oriented, and partnership-based precedents set by the diverse and growing network of federal agency-related foundations, a new DOE-related foundation should be set up with this aim. The report proposes this ETCF be charged by Congress with the mission of supporting DOE by strengthening U.S. competitiveness in a carbon-constrained world and appropriated $30 million to establish the foundation and an additional $3 million annually for administrative and operational expenses.

Opportunities to Strengthen IMPACT Bill

The IMPACT bill provides a strong framework to establish the Energy Technology Commercialization Foundation. It rightly identifies the foundation's central role to facilitate public-private partnerships to commercialize research and technology by bringing together the diversity of partners to create a pathway to commercialization for energy technologies. It also is laser focused on the valley of death and the activities needed to help bridge that gap including competitions, fellowships and grants, programs to support the numerous interactions required throughout the innovation process. Furthermore, the bill includes several critical authorities for the foundation to have the flexibility of a not-for-profit, as well as, provide administrative services to assist DOE.

To strengthen the bill, I suggest stronger language on how it will collaborate with the DOE and its labs and how a clearer strategy on how the foundation will support public-private collaborations.

<u>Foundation Collaboration with DOE and the Labs</u>

ETCF's governance structure must establish a clear mission, ensure the foundation is responsive to the public interest, and delineate a complementary and nonoverlapping relationship with DOE. As with

[15] Centers for Disease Control Foundation. Making an Impact: the CDC Foundation Responds to COVID-19. Accessed on July, 10, 2020. https://www.cdcfoundation.org/sites/default/files/files/COVIDresponseupdate9-2.15PM.pdf

other agency-related foundations, ETCF's authorization must provide minimum requirements for the composition of a diverse governing board, including membership for the senior leadership of DOE, and conflict of interest and ethics policies. Importantly, the authorization needs to create appropriate processes for streamlining contracting and administrative requirements between ETCF and the DOE that hamper DOE's technology commercialization efforts today.

Equally important for the bill are specific requirements for DOE to collaborate and coordinate with ETCF. Beyond the relationships established by board membership, the bill should also mandate internal DOE guidance, directives, and orders pertaining to an effective relationship with the ETCF. These official documents should be developed in partnership with ETCF and take into consideration concerns of all stakeholders, including the national laboratories. All guidance documents should be binding on all DOE units, including the National Nuclear Security Administration, ARPA-E, and other semiautonomous agencies within DOE. All DOE national laboratories, sites, and facilities should be allowed and encouraged to work with ETCF. The requirements on DOE to work with the foundation will help DOE prioritize and resource the relationship, which in turn will help enhance commercialization.

Strategy to Support Public-Private Partnerships

The authorization should also outline the main strategies, activities, and programs of the foundation. At the core of our design for ETCF are two strategies aimed at catalyzing and incubating collaborations between the public, private, and philanthropic communities to accelerate the commercialization of energy technology in the United States. An ETCF would:

1. respond to cross-cutting national challenges; and
2. strengthen regional energy innovation ecosystems.

These strategies build on distinctive attributes of existing agency-related foundations such as FNIH and FFAR that are particularly relevant to the energy industry and ETCF's transformative mission. The objective of the collaborations is to create partnerships that allow for the free flow of information across the valley of death, aligning the different players of the innovation process and reducing risk. This creates the demand or "user" pull needed to commercialize new technology. The bill should require the ETCF to submit a strategic plan to guide its initial activities, which would be updated after the first two years and then every five years after that. It should include strategies, such as the ones identified in the ITIF report, but it should also provide the foundation the flexibility to adjust these strategies to important technological advancements and societal needs.

Accountability and Evaluation

Finally, while the foundation will be a non-for-profit private organization, it is still created by Congress and should be appropriately accountable. The authorization should include annual reports and financial audits. All of these documents are standard for highly-effective non-profit organizations and parallel the requirements set forth by Congress for the other agency-affiliated foundations.

As discussed earlier, commercialization outcomes take a very long time, include multiple players, are not linear, and are often difficult to attribute to one specific action. Nonetheless, measurable goals that indicate whether these outcomes are likely to be achieved can and should be developed, and ETCF held to them. ETCF would work with experts on research evaluation to develop qualitative and quantitative metrics for the organization as a whole as well as its main activities and strategies. The bill should

require ETCF to incorporate and fund evaluation for projects and grants from the beginning, and periodically fund third parties to evaluate and provide feedback that informs program development.

Conclusion

There are many pathways that could lead to radical reductions in carbon emissions, all of them will be disruptive to major industries and require significant deployment of new technology, ranging from electric power to transportation to agriculture, not to mention fuels, chemicals, and materials. Yet, there are gaps in the energy innovation ecosystem and barriers to technology commercialization slowing down the transition of these industries. In IEA's 2019 report, "Tracking Clean Energy Progress (TCEP)," it found that 40 of 46 energy technologies are not on targeted to facilitate the world's ability to stay well below two degrees of global temperature rise by 2050.[16]

Furthermore, as may already be observed in sectors such as coal mining and solar panel manufacturing, the energy transition will create winners and losers across communities, companies, and countries. A country that strengthens its competitiveness is likely to weather the coming disruption better than one that fails to make the most of emerging opportunities. Yet, the country's response to COVID-19 demonstrates weaknesses in our ability to respond to science-based grand challenges.

The United States has much to contribute to the innovations that will power the energy transition and reduce the impact of the climate crises—and much to gain from them as well. The Energizing Technology Transfer Act does much to reform and improve DOE's ability to both originate and assist in the development of new technologies for this transition. The IMPACT bill, which creates a DOE foundation, would be a valuable mechanism for both enhancing the contributions the nation makes to this critical global effort and ensuring it receives a reasonable share of the economic gains from it.

[16] IEA. Tracking Clean Energy Progress. https://www.iea.org/topics/tracking-clean-energy-progress (2019).