BREAKTHROUGH INSTITUTE

A CLEAN ENERGY DEPLOYMENT ADMINISTRATION

UNLOCKING ADVANCED ENERGY INNOVATION AND COMMERCIALIZATION

Jesse Jenkins and Sara Mansur

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→ INTRODUCTION ←

For economic, security, and environmental reasons, the global energy system is modernizing and diversifying. Today's economies are still predominately fueled by conventional fossil energy sources first pioneered in the 19th century. The energy demands of the 21st century, in contrast, will be met by a portfolio of advanced energy technologies offering improved public health, strengthened energy security, and the affordable and reliable fuel needed for sustainable global development. The advanced energy technologies of this 21st century energy system are being invented and commercialized today, and some will ultimately become the dominant players in a $5 trillion global energy market expected to double in size by mid-century.

American innovators and entrepreneurs have historically powered extraordinary transformations of global economic markets and technology systems, from dramatically improved agricultural and manufacturing productivity to successive revolutions in transportation and communications. Fueled by American ingenuity, entrepreneurship, and the direct support of public policy, these transformations have driven the growth and competitiveness of the US economy for the past century.[1] American entrepreneurs are once again poised to invent and commercialize 21st century advanced energy technologies, creating new technologies to supply global markets and meet domestic energy needs with abundant, clean, affordable, and reliable fuels.

Unfortunately, until present, the ingenuity of American entrepreneurs and the potential of the US innovation system to transform energy markets have yet to be unlocked. The commercialization and deployment of innovative energy technologies has lagged far behind the scale necessary to meet the country's energy needs, while the cost of conventional clean energy technologies is still significantly higher than the cost of generating power from fossil fuels.

One major institutional obstacle impeding this progress is the considerable difficulty entrepreneurs face in securing adequate financing to demonstrate and commercialize their promising energy technologies. Despite an upsurge in private sector investment in clean energy innovation in the past few years, private investment remains inadequate to finance the commercialization of these innovative technologies, largely because of the high capital costs and perceived risks of investing in new and unfamiliar technologies. This has left many promising energy innovations in a "**Commercialization Valley of Death**," where a dearth of financing for first-of-a-kind commercial-scale demonstration projects means that many potentially game-changing technologies fail to ever make it into the marketplace. This persistent market barrier effectively insulates conventional fossil fuel-based energy technologies from new competitors, preventing a vibrant, fully competitive US energy market and impeding the development of clean, affordable, and reliable domestic energy sources.

For more on these challenges, please see "Bridging the Clean Energy Valleys of Death," Breakthrough Institute, Nov. 2011.[2]

Congress took important steps to address this Commercialization Valley of Death with the creation of the Department of Energy (DOE) Loan Programs Office, which now houses the Section 1703 and 1705 loan guarantee programs and the Advanced Technology Vehicle Manufacturing (ATVM) loan program. The recent high-profile bankruptcy of California solar manufacturer and Section 1705 loan guarantee recipient Solyndra has brought intense scrutiny to these programs, with many policymakers concerned about the independence and fiscal sustainability of the Loan Programs Office. The Commercialization Valley of Death continues to plague American entrepreneurs, however, and policymakers should take this as an opportunity for a smart reassessment of government's role in addressing the persistent lack of financing for innovative clean energy ventures.

In particular, the Breakthrough Institute recommends seizing this moment to establish a new **Clean Energy Deployment Administration** (CEDA), a government-owned non-profit financial entity—effectively a bank—that offers a flexible suite of investment vehicles for promising and innovative advanced energy ventures currently trapped in the Commercialization Valley of Death.[3] CEDA would replace and improve on the troubled DOE Loan Programs Office and incorporate key reforms to address lessons learned from the experience of the loan programs:

FIRST, modeled after the US Export-Import Bank (Ex-Im) and Overseas Private Investment Corporation (OPIC), CEDA would act as a flexible and independent government financial agency, insulated from the potential for politicization and interference by White House or Office of Management and Budget officials or DOE political appointees.

SECOND, like Ex-Im and OPIC, CEDA's skilled team of financial experts would manage a portfolio of investments that would generate returns and become self-financing over time. Unlike one-time government payments such as grants or tax credits, CEDA would have the flexibility to re-use returns on investments to back new private investments, highly leveraging limited taxpayer resources for maximum impact.

THIRD, instead of relying on a single financial mechanism (e.g., loan guarantees), CEDA would be armed with a flexible tool-kit of investment vehicles and credit enhancement mechanisms to unlock and leverage private sector investment in promising advanced energy technologies.

FINALLY, CEDA would be exempt from the typical hiring rules of government agencies, giving it the flexibility to recruit and retain an experienced and talented staff steeped in innovative technology fields, risk mitigation and financial products, and project financing.

Structured in this manner, CEDA will play a vital role in supporting American entrepreneurs and start-up technology ventures and unlocking advanced energy innovation and commercialization throughout the nation.

→ I. THE COMMERCIALIZATION VALLEY OF DEATH CHALLENGE ←

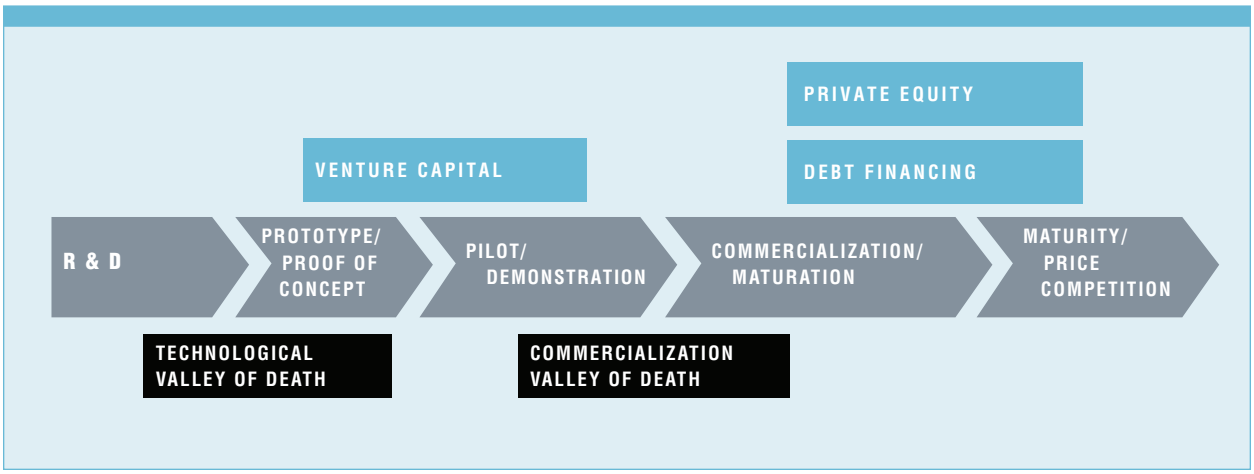
The Commercialization Valley of Death exists for technologies that have already demonstrated proof of concept, yet require upwards of hundreds of millions of dollars to demonstrate that their technologies and manufacturing processes can be valid at a full commercial scale.

Typically, venture capital funds are responsible for financing early-stage, high-risk ventures from early development to initial commercialization. However, energy technologies are often much more capital-intensive than traditional innovations, such as relatively low-capital Internet or software startups. Innovative energy technologies generally require funding beyond the traditional scope of venture capitalists, whose financing generally averages around $10 million dollars per investment[4] In contrast, the construction of full-size energy demonstration projects, such as utility-scale power plants or manufacturing facilities, often requires financing on the order of several hundred million dollars or more.

Alternatively, traditional project finance lenders, like traditional banks and investment banks, have the funds to invest in much more capital-intensive projects than venture capitalists. However, these lenders, are unwilling to tolerate a high amount of risk and resultantly are reluctant to invest in the first iterations of technologies and projects that have not yet been demonstrated at a commercial scale. "Markets operate in a risk-reward paradigm," explains the US Chamber of Commerce's Christopher Guith, and "they generally fall on the risk averse side when considering the deployment of new technologies, especially in the energy industry."[5]

Figure 1:

THE ENERGY INNOVATION CYCLE AND THE CLEAN ENERGY VALLEYS OF DEATH



As a result, many energy technologies fall prey to this Commercialization Valley of Death, having exhausted the (comparatively) small investments of venture capitalists yet remaining too risky to be attractive to traditional debt or equity finance. Examples of advanced energy technologies plagued by the Commercialization Valley of Death include: carbon capture and sequestration, enhanced/engineered geothermal, advanced solar power and battery manufacturing processes, advanced biofuel production facilities, and small modular nuclear reactors.

The Commercialization Valley of Death represents an institutional barrier, as no particular set of private actors or institutions is well equipped or willing to bear the risks or invest the capital on their own to help an energy technology cross the bridge between development and deployment.

As Kassia Yanosek, of Hudson Clean Energy partners, argues:

"The Commercialization gap is a persistent financing challenge. If we can find ways to reduce risk or reduce our cost of capital, that's when you'll start to see private equity come in and actually scale these technologies. The valley of death is fundamentally a risk–return challenge for us."[6]

By shouldering a portion of this risk itself, the public sector can play a crucial role in mitigating the real and perceived risks associated with commercializing advanced energy technologies, the private sector will unlock a substantial amount of subsequent private sector capital investment.[7]

→ II. THE CLEAN ENERGY DEPLOYMENT ADMINISTRATION ←

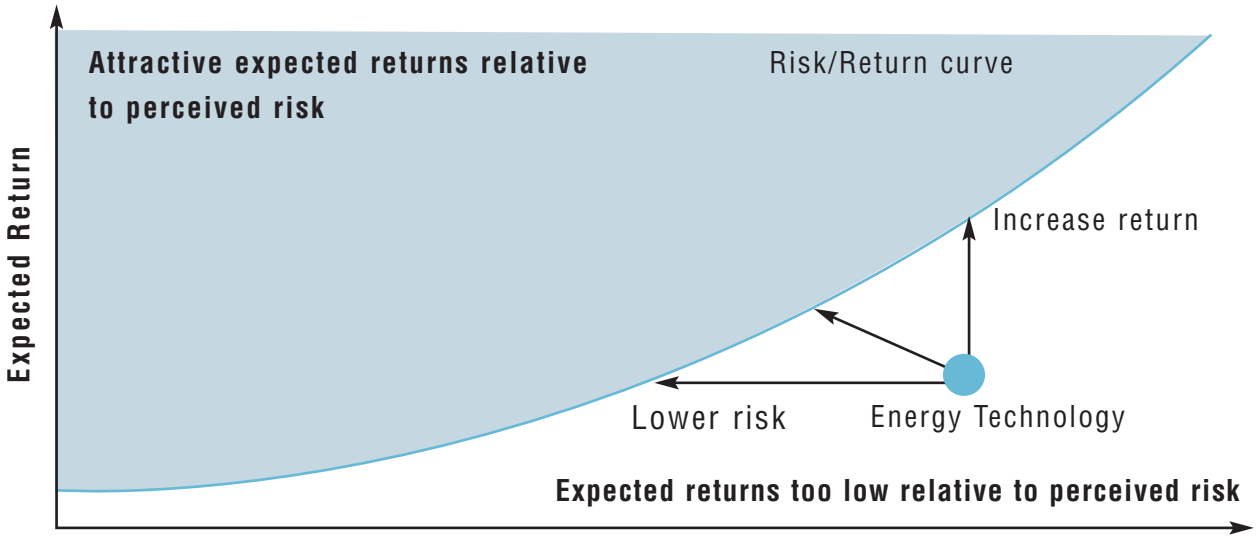
UNLEASHING CLEAN ENERGY INNOVATION AND ENTREPRENEURSHIP

The Clean Energy Deployment Administration addresses a clear and persistent gap in financing for clean energy technologies through an independent, government-backed, advanced energy commercialization investment authority. By attracting private sector investment in the development and deployment of innovative advanced energy technologies, the agency has the potential to unlock the capital necessary to move technologies across the Commercialization Valley of Death.

CEDA would pursue this goal by utilizing a flexible suite of investment vehicles and credit enhancement mechanisms to support the commercialization and deployment of these nascent advanced energy technologies, including but not limited to: an advanced energy investment fund, direct loans, loan guarantees, insurance products, letters of credit, and advanced energy project-backed bonds to reduce lending rates in the private sector. These tools would unlock the private sector funds that currently elude nascent energy technologies by mitigating a portion of the risk associated with financing these technologies and helping reduce the risk vs. return profile for these advanced technology ventures, such that investment would become acceptable to typical debt and equity finance entities.

Figure 2:

RISK VS. RETURN AND THE COMMERCIALIZATION VALLEY OF DEATH



Source: Harvard University, Belfer Center for Science and International Affairs[8]

The purpose of this long-term federal program is to catalyze and support the demonstration, commercialization, and deployment of the most innovative advanced energy technologies, those that are currently perceived as too risky to attract traditional private-sector finance and are therefore stuck in or at risk of being trapped in the Commercialization Valley of Death. CEDA would be technology neutral, with a mandate to accelerate the commercialization of any promising advanced energy technologies with the potential to substantially reduce America's dependence on energy imports, minimize greenhouse gas emissions and public health impacts, and improve US energy productivity. The program would selectively target breakthrough energy technologies with the potential to become independent of ongoing subsidy as they mature, yet that are at present simultaneously too capital-intensive for venture capital investment and too risky for private equity financing. This public-private partnership will encourage innovative technologies to reduce technology risk and progress towards cost parity with conventional fossil fuel-based energy technologies.

It should be noted that this program is not a subsidy or taxpayer expenditure, but is rather a directed government investment program that aims to bring down the cost of innovative technologies over the long-term, with the aim of phasing out other public subsidies for advanced energy technologies and enabling these technologies to compete with conventional fossil fuels on cost alone.[9]

While CEDA would be seeded through an initial capitalization of government funds, it would operate autonomously, run like a non-profit, private-sector investment fund with returns to the fund generated over time by successful investments. CEDA would differ from the DOE's current loan guarantee program both by being equipped with a more flexible toolkit of financial tools and by maintaining a revolving "Clean Energy Investment Fund," which would allow the program to be self-sustaining, operating independently of the annual Congressional budget appropriations process.[10] In this manner, CEDA would build on the successful precedent of the independent US Export-Import Bank (Ex-Im) and Overseas Private Investment Corporation (OPIC), which both return a net profit to the US Treasury, while leveraging private investment to support American businesses.

According to the US Chamber of Commerce's Christopher Guith:

"A quasi-governmental agency like [CEDA] … could provide the flexible financial risk management tools currently employed to advance other long-term goals (e.g. exports at the Export-Import Bank and emerging market investment at the Overseas Private Investment Corporation) to our capital-intensive clean energy goals. This is why we supported CEDA in 2009 and continue to support it today."[11]

CAPITALIZING CEDA

CEDA would be funded by a modest up-front appropriation that would back initial investments in a portfolio of emerging energy technologies. This one-time appropriation would eventually give way to a self-sustaining program that would recoup and reinvest its profits over time. Structured in the manner, CEDA staff and fund managers would also face strong, market-based incentives to responsibly manage the agency's overall portfolio of investments to shepherd this initial taxpayer investment for long-term impact.

We recommend that CEDA replace the DOE Loan Programs Office, home to the Section 1703 and 1705 loan guarantee programs and the Advanced Technology Vehicle (ATVM) loan program, which reduce the cost of debt financing for innovative energy technologies.[12] CEDA would incorporate these functions into the flexible suite of financing and risk mitigating tools at the agency's disposal. As such, any remaining money appropriated to the DOE Title 17 Loan Guarantee Programs or the ATVM could act as offsets for all or a portion of the funding required to capitalize CEDA. The DOE Loan Program Office would continue running until CEDA was fully established, maintaining the office's existing portfolio of loans and guarantees in this transitional stage and would then be absorbed by CEDA.

As its purpose is to encourage the deployment of technologies deemed too risky for solely private investment, CEDA will need to have a higher risk tolerance than commercial lenders. To do so, the agency will require a portfolio investment approach, pooling a diversified set of technologies to balance higher-risk investments with revenues from other, relatively low-risk investments. In this manner, through an initial capitalization, CEDA could maintain a portfolio of investments and credit enhancement mechanisms that would unlock substantial public and private-sector financing for innovative energy technologies.[13]

SELF-SUSTAINING FINANCING MECHANISMS

Beyond the seed funding granted to the program by the government, CEDA has the capacity to become self-sustaining by employing various financial mechanisms. The Clean Energy Investment Fund could be established as a revolving loan fund whereby loans are paid back into the fund along with appropriate interest or fees, making the fund self-sustaining beyond initial capitalization.

The agency would be able to charge appropriate fees for its financing services, such as loan loss reserve requirements or credit subsidy payments. Through these mechanisms, more conventional, later-stage

technologies with the ability to "self-pay," like conventional nuclear power plants, could pay for their credit subsidy costs. This would allow CEDA to finance higher-risk, first-of-a-kind or advanced technologies, balanced by a portfolio of less risky technologies, while properly aligning incentives so that CEDA can maximize returns to taxpayers. The Congressional Budget Office (CBO) has estimated that up to $100 billion of advanced energy technology loans could be guaranteed through self-pay mechanisms, for example. Additionally, by charging appropriate fees to cover the risks associated with the agency's financial products, CEDA would generate ongoing revenues and would not have to wait for new support through the annual appropriations process.

Finally, through a "profit participation" mechanism, CEDA could obtain equity stakes or profit participation agreements in successful companies. This way, CEDA would increase its return from investments in these high-risk yet high-reward technologies over the longer term, providing capital for additional project financing or risk mitigation products. These mechanisms would allow CEDA to take risks with the most innovative technologies and be rewarded accordingly, increasing the self-sustainability of the agency.

CEDA should be allowed to set the terms of conditions for cost recovery of loan guarantees and other financing and credit enhancement products independently of the OMB, such that conditions could be set and adjusted quickly and flexibly in order to be tracked with prevailing market conditions and to work as closely with the private sector as possible.[14] This independence would also insulate the agency from potential White House political interference.

BUDGET IMPACT

CEDA is, at its base, an investment agency that leverages a small amount of government funds to unlock larger sums of private capital, and has the potential to unleash high returns—both directly to the agency itself, as well as for the economy as a whole. As CEDA would issue loans and establish loan guarantee programs with the expectation that, on balance, all loans be paid back at the end of the period, this program should be scored by the CBO as an *investment subsidy*, rather than as a grant or federal outlay. CEDA's Clean Energy Investment Fund would be run as a self-sustaining revolving loan fund, with some return on each successful investment accruing to the investment fund, highlighting the fact that this program should be treated as a government investment, rather than as a subsidy or as traditional consumptive spending. CEDA's ultimate impact on the federal treasury is likely to be minimal, if not revenue-earning. Indeed, both the Ex-Im Bank and OPIC return a net profit to the federal Treasury.

In part recognizing these attributes of the proposed agency, CBO has scored the budget impact of the Senate-proposed authorizing language for CEDA at $1.1 billion over five years, even though the

agency is likely to leverage that initial funding to unlock significantly larger private-sector investment in advanced energy projects as well as ongoing revenues to sustain CEDA's ongoing investments.[15]

As mentioned previously, some or all of this estimated budget impact could be offset by absorbing existing funds appropriated to the Title 17 loan guarantee and ATVM loan programs. For example, ATVM was appropriated $7.5 billion by the American Recovery and Reinvestment Act to cover potential losses on its portfolio of loans, but has to date utilized just $3.5 billion of these funds.

STRUCTURE AND STAFFING

As the purpose of CEDA is to unlock private sector capital flows, it is imperative that the agency be structured to attract as much private sector, project finance, and financial products expertise as possible, and to be as fluid and dynamic in its staffing as a private sector enterprise.

CEDA is to operate as an autonomous administration within the Executive branch, much like the existing Ex-Im Bank and OPIC. This independent structure would insulate the agency from political interference and allow the agency to focus on advancing its mission: helping American entrepreneurs and firms invent and commercialize clean, affordable, reliable advanced energy technologies to meet domestic energy needs and supply the multi-trillion global energy market.

The organization's goals for technology deployment would be aggressive, set by an independent advisory council. This council could be composed of a Board of Directors, comprised of the DOE Secretary, a CEDA Administrator, and additional members, who should represent a range of perspectives from the private sector and research community with extensive experience working in these innovative technology markets. An Administrator would govern CEDA, and a permanent Technological Advisory Committee would advise on the technical aspects of new technologies.

In order to attract the most talented experts in innovative technology fields, risk mitigation and financial products, and project financing, hiring authority should be exempt from traditional federal hiring requirements, as is the case with DOE's Advanced Research Projects Agency-Energy (ARPA-E). These exemptions have allowed ARPA-E to handpick a team of scientists, engineers, and businessmen who have a close working knowledge of innovative technologies and private sector financing needs. Additionally, this has allowed ARPA-E to maintain an agile workforce, where employees take federal positions for shorter time periods in order to maintain a staff that is in close relationship with private sector developments. This would allow CEDA to quickly and efficiently hire new staff without undergoing the standard, and often slow, federal hiring process. Following the same reasoning, board members, the Administrator, and CEDA staff would be compensated at wage levels that ensure high-quality talent can

be acquired.[16]

REPORTING STRATEGY AND SUCCESS MEASUREMENTS

The primary goal of CEDA will be to help expand financing opportunities for advanced energy technologies and accelerate the development cycle of innovative technologies from the typical 15–20 years to a 10-year or shorter cycle. As the US Chamber of Commerce's Guith explains:

"Mitigating technology risk traditionally takes years of waiting for the empirical results of a pilot project, a demonstration facility, a semi-scale facility and then a full commercial scale project. … [O]vercoming the technology hurdle will take years if left to business-as-usual market processes." [17]

In order to accelerate this commercialization process, CEDA must operate in close cooperation with the financial community, as the program is filling an investment gap left by the private sector and aiming to unlock and leverage much larger private capital flows. To be successful, the program must have perceived and real longevity and stability, creating business confidence by ensuring private funders that the program will remain funded over the long-term. As such, CEDA's performance should not be based on the usual metrics used to judge the success of government programs, which are often expected to create jobs quickly and show immediate results.

The success of CEDA will have to be measured by the success of the entire program portfolio over a longer period of time, as certain technological investments will inevitably fail, while others will prove to be extremely successful. While CEDA should report annually to the Energy Secretary and Congress on the agency's current investments, to ensure that the program has the flexibility it requires, the agency should be able to autonomously manage its portfolio of investments after initial appropriations to capitalize the fund, insulating the agency from the typical annual appropriations process. Having CEDA be an annual line item would risk misrepresenting the agency as a short-term program with the ability to demonstrate results on an annual basis, which is not the case with such long-term investment objectives.[18]

CEDA'S INTERACTION WITH PRIVATE SECTOR INVESTMENT

From 2004 to 2008, conventional venture capital and private equity investment in clean energy technologies increased dramatically, from $1.5 billion in 2004 to $11.9 billion in 2008, before falling to $6 billion in 2010.[19] If a public financing entity of the same nature as CEDA had been created to target these exact funds, it could have crowded out some of this private sector financing, with its significant advantage in access to patient government capital, driving these venture capitalists and private equity financiers from the market.

It is thus important to ensure that any public finance entity has the right, targeted focus on advanced technologies that the private sector cannot finance on their own. Some public finance proposals, such as the "Green Bank Act of 2009" or recommendations to include energy projects within a proposed National Infrastructure Bank, would focus investments on more conventional technology projects, such as wind farms, that have already reached commercial maturity. These technologies have been (at least temporarily) plagued by the high cost of capital and lack of liquidity in the debt and tax equity markets due to the global financial crisis. These proposals could therefore provide affordable debt financing to overcome these investment obstacles and lower the final cost of renewable energy generation and other clean energy projects. However, these proposals address a much more short-term and likely temporary private investment gap, and in the long run must take care to avoid simply competing with private sector banks for the same portfolio of commercial projects.

As proposed here, however, CEDA will be highly targeted and designed to address the Commercialization Valley of Death, a proven and persistent phenomenon in the clean tech market. CEDA will therefore fill a permanent gap left by private sector investors, rather than crowd them out.[20] CEDA could also fund conventional technology projects to an extent. However, this funding would operate outside of the initial capitalization of the fund, through "self-pay" mechanisms such as fees for financing services, as part of a broader portfolio of projects designed to facilitate the program's primary objective: accelerating the commercialization of advanced, emerging clean energy technologies plagued by the Commercialization Valley of Death. This focus on emerging technologies aims to address the permanent, structural financing gap that exists between the deployment and commercialization phases of the technology development cycle and which is not addressed by private-sector financing entities, rather than the temporary financing gap that exists in the current poor credit environment.[21]

CEDA will maintain a close, working relationship with private markets, and closely monitor developments in the private sector, to ensure that the appropriate financing gaps are being addressed and the

agency is not competing directly with private financing entities or crowding out private investment. In contrast, CEDA's role will be to unlock and support private sector investments in energy technologies, by shouldering a significant portion of the risk involved in financing these advanced energy technologies.[22]

→ CONCLUSION ←

The Commercialization Valley of Death presents a substantial obstacle for American energy entrepreneurs, one that has, until present, impeded the pace of commercialization and deployment of advanced energy technologies. This is an institutional gap, plagued by an acute lack of actors that are willing and able to take on the role of financing the demonstration and commercialization of capital-intensive energy technologies, particularly early-stage or first-of-a-kind technologies, and the inherent risks that accompany this role.

Innovative public policy is required to fill this institutional gap and unlock private sector investment in this critical stage of the technology cycle. The public sector's role is crucial, as it is only through creative public policy that these technologies will be able to secure the capital and resources necessary to advance to the marketplace. At present, too many game-changing energy technologies fall prey to this Commercialization Valley of Death, unable to secure financing and receive a chance to compete in the marketplace with conventional energy technologies. In taking the steps necessary to address this gap, the country will begin to unlock the American innovation system, unleashing the forces of innovation, competitiveness, and economic transformation that have driven the country's growth throughout our history.

→ NOTES AND CITATIONS ←

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Breakthrough Institute

436 14th Street, Suite 820
Oakland, CA 94612
Phone: 510-550-8800

www.thebreakthrough.org