More and Better: Building and Managing a Federal Energy Demonstration Portfolio

By Robert Rozansky and David Hart

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New ITIF Report on Clean Energy Demonstration

- Introduction to *demonstration*: a critical, underfunded stage of the energy innovation process
- Discussion of large-scale clean energy technologies ready for demonstration
- Analysis of proposals to reform the federal demonstration program
- PDF available at https://itif.org/sites/default/files/2020-energy-demonstration-projects.pdf

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Demonstrating the commercial viability of new technologies for deep decarbonization requires federal funding. But the government's past record is decidedly mixed. So Congress should increase funding for demonstration projects while reforming how they are administered.

KEY TAKEAWAYS

- Promising clean energy technologies—especially complex, capital-intensive, large-scale technologies—too often remain on the cusp of commercial deployment because they have not been effectively demonstrated.
- The federal government should substantially increase its investment in clean energy demonstration projects, and Congress should establish an Office of Major Demonstrations at DOE with dedicated funding to manage this expanded portfolio.
- The focus should be on large-scale technologies that can achieve deep decarbonization, including advanced nuclear power, long-duration grid storage, carbon-neutral fuels, carbon capture and storage, and carbon removal.
- Federal funding is critical for energy demonstration projects, because the risks are often too high for private investors. Yet the government's past record is marred by drawn-out support for failed megaprojects and periods of stagnant investment.
- Given the historical record, policymakers may be reluctant to fund energy demonstration projects until there are substantial reforms to how they are administered. Academic literature, including prior ITIF research, offers an actionable framework.

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Demonstration is a Critical Stage in the Innovation Process (1/2)

- Clean energy innovation is needed to solve climate change. Existing low-carbon technologies are not yet effective, reliable, and affordable enough.
- Many promising, new clean energy technologies—such as long-duration storage, clean hydrogen production, and carbon capture and storage—are on the cusp of commercial deployment, but have not been sufficiently de-risked for the private sector to adopt them.
- De-risking is the key role of *demonstration*, i.e., the "operation of a prototype…at or near commercial scale with the purpose of providing technical, economic and environmental information." (International Energy Agency)
- Demonstration is especially important for large-scale, complex technologies that that may face new scale-up, integration, management, and other types of challenges at full size.

Demonstration is a Critical Stage in the Innovation Process (2/2)

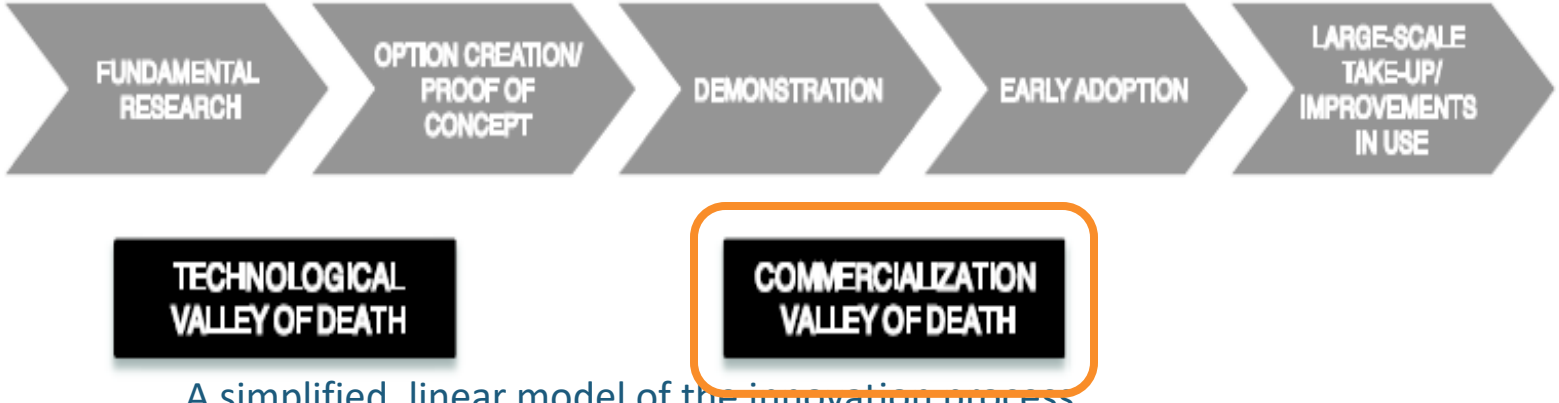
- Demonstration has multiple functions:
  - Establish cost and performance metrics in real-world conditions
  - Debug integration and operation of multiple complex subsystems
  - Reduce economic and institutional risks of deployment
  - Build confidence among investors, regulators, the public, and other stakeholders

A simplified, linear model of the innovation process

Image credit: National Academies of Sciences, Engineering, and Medicine, *The Power of Change*.

Demonstration is an Innovation Valley of Death

- First-of-a-kind large-scale, complex systems are expensive and risky, which dissuades private companies from investing in them alone.
- The federal government has supported demonstration in the past, but has a mixed record, marred by drawn-out support for failed megaprojects and periods of stagnant investment.
- Absent public funding, technologies in need of demonstration can get stuck in the "commercialization valley of death."



A simplified, linear model of the innovation process

Image credit: National Academies of Sciences, Engineering, and Medicine, *The Power of Change*.

The theory and history of federal demonstration is explored in greater detail in ITIF's 2017 report "Across the 'Second Valley of Death': Designing Successful Energy Demonstration Projects"

Recommendations

To build a robust demonstration portfolio and unlock technologies key to decarbonizing the economy, ITIF offers two recommendations:

1. More. The federal government should substantially increase its investment in clean energy demonstration projects.

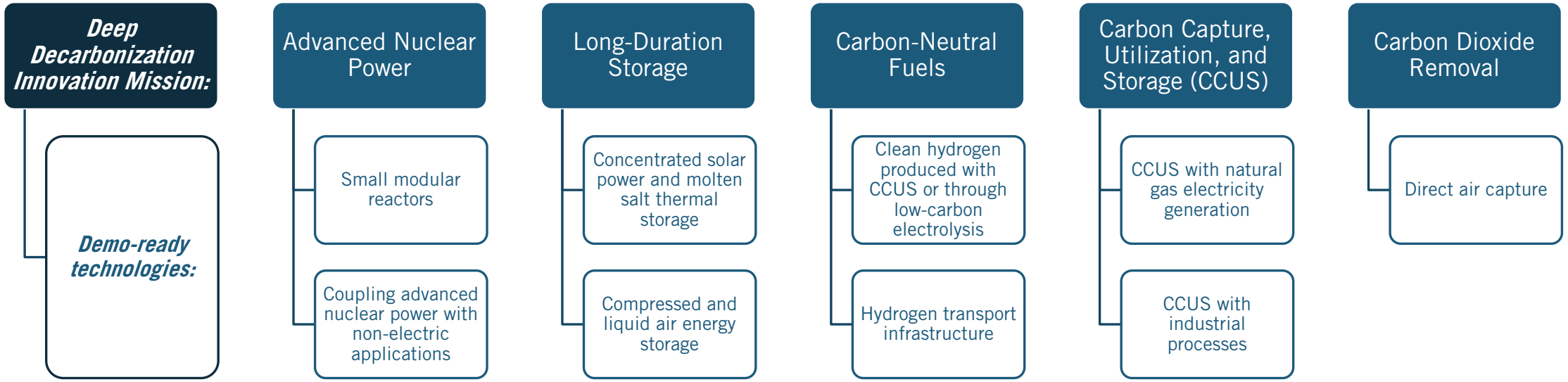
2. Better. Congress should establish a Department of Energy (DOE) Office of Major Demonstrations to improve demonstration project administration.

Recommendation #1: Increase Investment in Demonstration

- Today, the federal government funds very few large-scale clean energy demonstration projects. The last major investment in demonstration was through the American Recovery and Reinvestment Act (ARRA) of 2009.
- Funding large-scale demonstration projects is expensive.
  - Large-scale demonstration projects may cost hundreds of millions or billions of dollars.
  - Multiple projects may be needed to identify and de-risk successful pathways for a single technology.
- A budget of at least $5 billion per year would support several very large demonstration projects and many smaller ones.

Which Technologies Should Be Demonstrated?

Demonstration funding should go towards promising technologies that are ready for demonstration and will support deep decarbonization. Among five deep decarbonization innovation missions previously identified by ITIF, examples include the following:



Recommendation #2: Establish a DOE Office of Major Demonstrations

- Demonstration projects are typically managed by the relevant DOE Applied Office (e.g., Office of Fossil Energy, Office of Energy Efficiency and Renewable Energy).
- But there is room for improvement. Ideally, the entity responsible for demonstration project administration should ensure steady and sufficient funding, coordinate a strategic portfolio, insulate project decisions from political influence, and provide expertise in large-scale project management.
- Several reform proposals have been put forth, all of which have strengths and weaknesses.
- We recommend the establishment of a DOE Office of Major Demonstration.

Five Options for Demonstration Project Administration

The Default Option:

The **DOE Applied Offices** continue to fund and manage individual projects.

Option #2:

A **DOE Office of Major Demonstrations**, staffed with project management expertise, oversees a demonstration portfolio across multiple technology areas.

Option #3:

A **Quasi-governmental Demonstration Corporation** independently finances and oversees a portfolio of large-scale energy demonstration projects.

Option #4:

A non-profit national **Green Bank** facilitates private investment into low-carbon infrastructure, including demonstration projects.

Option #5:

Regional Demonstration Funds across the country representing local utilities support and manage electricity sector demonstration projects.

Eight Precepts To Guide Demonstration Project Administration

1. Develop and maintain a strategic portfolio,
2. Apply expert management practices, particularly project management and finance,
3. Avoid political influence,
4. Tailor cost-share agreements to each project's risks and benefits for its partners,
5. Facilitate knowledge sharing by private sector project partners,
6. Ensure strong cross-sector linkages upstream and downstream,
7. Enhance coordination among federal, state, and intl. projects and programs, and
8. Ensure steady and sufficient funding for the portfolio

Mapping Precepts To Options (more detail in the appendix)

	DOE Applied Offices	DOE Office of Major Demonstrations	Quasi-governmental Demonstration Corp.	Green Bank	Regional Demonstration Funds
Would this administration…					
Develop and maintain a strategic portfolio?	No	Yes	Yes	No	No
Apply expert management practices?	Maybe	Yes	Yes	Maybe	Maybe
Avoid political influence?	No	No	Yes	Yes	Maybe
Tailor cost-share agreements?	Maybe	Yes	Yes	Maybe	Maybe
Facilitate knowledge sharing?	Maybe	Yes	Yes	Maybe	Maybe
Ensure strong upstream linkages?	Yes	Maybe	No	No	Yes
Ensure strong downstream linkages?	Yes	Yes	Yes	Yes	Yes
Enhance coordination among federal, state, and international partners?	Yes	Yes	Maybe	Maybe	No
Ensure steady and sufficient funding?	No	Maybe	Yes	No	Yes
…And is this reform politically feasible?	Yes	Yes	Maybe	Maybe	Maybe

Highlights of Analysis (1/2)

- Given its independence, commercial ties, and demonstration focus, a **quasi-governmental demonstration corporation** would be likely to maintain a strategic portfolio, effectively manage projects, and encourage follow-on investment. But it is unlikely Congress would allocate the funds and oversight needed to establish it.
- A **green bank** has similar strengths and weaknesses, except that its focus on deployment could lead to an overly conservative demonstration portfolio.
- **Regional demonstration funds** offer strong upstream and downstream linkages to regional innovation ecosystems but would likely be unworkably complicated.

Highlights of Analysis (2/2)

- Establishing a DOE Office of Major Demonstrations is more politically feasible than the alternatives and would offer distinct advantages with respect to the status quo, especially in these respects:
  - Ability to develop strategic portfolio of demonstrated technologies
  - Staff with expertise in project management and finance
  - Well-positioned to work with DOE applied offices, Loan Programs Office, and other partners across the private sector, academia, industry, and the international community

Thank You!

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Appendix: How might each reform proposal adhere to precepts for demonstration management administration?

Default Option: DOE Applied Offices

Could the DOE Applied Offices…		Explanation
Develop and maintain a strategic portfolio?	No	There is a lack of a coordinated strategy among offices on technology demonstration.
Apply expert management practices?	Maybe	Program managers are typically technology experts, rather than project managers. DOE has a mixed record of project management.
Avoid political influence?	No	Office budgets are typically subject to the annual Congressional appropriations process.
Tailor cost-share agreements?	Maybe	DOE has the statutory authority to do so but has not always exercised it.
Facilitate knowledge sharing?	Maybe	DOE could apply this criterion more effectively in making awards and providing support.
Ensure strong upstream linkages?	Yes	DOE has close linkages with the National Laboratories and academia.
Ensure strong downstream linkages?	Yes	DOE has close linkages with many companies and industry organizations.
Enhance coordination among federal, state, and international partners?	Yes	DOE is well-positioned to coordinate with its partners and frequently engages such in partnerships.
Ensure steady and sufficient funding?	No	Budgets are typically subject to the Congressional appropriations process.
…And is this reform politically feasible?	Yes	It is the status quo—all that is needed is funding for specific demonstration projects.

Option 2: DOE Office of Major Demonstrations

Could a DOE Office of Major Demonstrations…		Explanation
Develop and maintain a strategic portfolio?	Yes	The office could coordinate its portfolio across technologies in line with roadmapping activities and leadership priorities.
Apply expert management practices?	Yes	The office could hire project managers with appropriate expertise to supplement DOE's technology expertise.
Avoid political influence?	No	If funded through Congressional appropriations, the office's activities would be subject to political influence.
Tailor cost-share agreements?	Yes	DOE has the statutory authority to do so but has not always exercised it. Given the office's expertise in demonstration, this should be a priority.
Facilitate knowledge sharing?	Yes	Given the office's expertise in demonstration, DOE could apply this criterion more effectively in providing support.
Ensure strong upstream linkages?	Maybe	Existing DOE programs have strong linkages with the National Laboratories and academia, but the new office would have to find ways to draw on them.
Ensure strong downstream linkages?	Yes	This office would create close linkages with the private sector through its project management.
Enhance coordination among federal, state, and international partners?	Yes	DOE is well-positioned to coordinate with its partners and frequently engages such in partnerships.
Ensure steady and sufficient funding?	Maybe	If funded through Congressional appropriations, the office would be subject to funding uncertainty.
…And is this reform politically feasible?	Yes	It would require reorganization within DOE.

Option 3: Quasi-governmental Demonstration Corporation

Could a Quasi-governmental demonstration Corporation…		Explanation
Develop and maintain a strategic portfolio?	Yes	The corporation could support a balanced portfolio of demonstration projects.
Apply expert management practices?	Yes	The corporation could hire experts in project finance and management on a commercially-competitive basis.
Avoid political influence?	Yes	The corporation would be funded with a lump sum and not subject to annual appropriations.
Tailor cost-share agreements?	Yes	The corporation could be established with this statutory authority.
Facilitate knowledge sharing?	Yes	The corporation could provide financial support contingent on knowledge sharing.
Ensure strong upstream linkages?	No	The corporation would likely not have strong linkages to the research community.
Ensure strong downstream linkages?	Yes	The corporation would likely have strong linkages to the private sector.
Enhance coordination among federal, state, and international partners?	Maybe	The corporation might have challenges coordinating with public sector partners, since it would be outside the federal government.
Ensure steady and sufficient funding?	Yes	The corporation would receive one large initial ten-year appropriation, subject to renewal.
…And is this reform politically feasible?	Maybe	It would require a large appropriation and for Congress to forego influence over project selection and funding.

Option 4: Green Bank

Could a Green Bank…		Explanation
Develop and maintain a strategic portfolio?	No	The bank would be challenged to support demonstration projects because of the need to be self-financed.
Apply expert management practices?	Maybe	The bank could hire experts in project finance and management if demonstration were made a priority.
Avoid political influence?	Yes	The bank would be independent from the appropriations process, assuming authorized funding is appropriated.
Tailor cost-share agreements?	Maybe	The bank could be established with this statutory authority.
Facilitate knowledge sharing?	Maybe	The bank could provide financial support contingent on information sharing.
Ensure strong upstream linkages?	No	The bank would have weak linkages to DOE, the National Laboratories, and academic R&D.
Ensure strong downstream linkages?	Yes	The bank would have strong linkages to the private sector.
Enhance coordination among federal, state, and international partners?	Maybe	Semi-independent from government, the bank might have difficulty coordinating investments with other partners.
Ensure steady and sufficient funding?	No	The bank would be challenged to support demonstration projects because of the need to be self-financed.
…And is this reform politically feasible?	Maybe	It would require a large appropriation and for Congress to forego influence over project selection and funding.

Option 5: Regional Demonstration Funds

Could Regional Demonstration Funds…		Explanation
Develop and maintain a strategic portfolio?	No	Limited to the electricity sector; reflecting regional interests but lacking national coordination.
Apply expert management practices?	Maybe	The regional boards could house expertise in project management and finance but might be uneven.
Avoid political influence?	Maybe	The federal gatekeeper would seek to limit the influence of state and regional interests.
Tailor cost-share agreements?	Maybe	Funds could be established with this statutory authority.
Facilitate knowledge sharing?	Maybe	Funds could be established with this statutory authority.
Ensure strong upstream linkages?	Yes	Funds would have very strong linkages to regional innovation ecosystems.
Ensure strong downstream linkages?	Yes	Funds would have very strong linkages to end users selecting projects.
Enhance coordination among federal, state, and international partners?	No	Coordination is possible but unlikely in a decentralized system.
Ensure steady and sufficient funding?	Yes	Funds would be removed from the appropriations process and derived from a dedicated source.
…And is this reform politically feasible?	Maybe	It would require the establishment of many new organizations and buy-in from a diverse set of partners.