DAY ONE PROJECT

# A Foundational Technology Development and Deployment Office to Create Jobs

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## Summary

The history of the United States is replete with examples of how foundational new technologies can transform the economy and create jobs. From the automobile to the transistor to recombinant DNA, foundational technologies have enabled an expanding middle class and prosperity for millions of Americans. The U.S. federal government has played a vital role in providing and enabling early market development and applications for these technologies. The United States must rededicate itself to promoting new technologies beyond the research and development phase if it is to maintain a position of global economic leadership and successful transition to the 21st century economy.

The U.S. government should create a Foundational Technology Development and Deployment Office within the Department of Commerce that retains flexible financing authority to support market-pull programs for early-stage commercialization of innovative firms. An annual $50 billion authorization, for five years, would spark nascent strategic industries (e.g. new energy production and distribution, advanced manufacturing, synthetic biology, materials, robotics, mobility, space exploration, and next-generation semiconductors), and would be critical to transitioning the U.S. workforce for the 21st century economy. With the success of such an office, the U.S. will cement itself as the global locus of frontier technology industries. The country could also ensure that the economic spillovers from innovation are distributed more equally across socio-economic groups, through the creation of more domestic, advanced manufacturing that creates middle-skill jobs.

## Challenge and Opportunity

The next generation of foundational technologies are ready to scale here in the U.S., but support for and investment in foundational frontier tech falls outside of the ability of most private sector firms for a few reasons:

- These technologies need more time to mature, with experimentation cycles misaligned to return expectations of private capital.
- Capital gaps exist in multiple locations along the company development timeline.
- Regulatory constraints increase hurdles for startup firms.
- Commodity markets generally have weak appropriability regimes, limiting the set of strategic choices for firms.

Traditionally, public sector interventions have focused on supporting early stage technology development (through productive programs at the Department of Defense and Department of Energy, for example ARPA-E). Simultaneously, private sector interventions are evolving to internalize the technology development risk through funds with longer return horizons (e.g. The Engine and Breakthrough Energy Ventures), and creative financial engineering to pool capital with different risk tolerances (e.g. Prime Coalition).

Despite this progress, there remain significant barriers to the scale up of frontier technologies. Barriers that stem not from the inherent technical challenges of innovation, but rather from the market dynamics in which these technologies have to compete. Companies face three distinct, but related barriers:

- Funding of capital intensive early-stage pilots. Companies have to balance achieving meaningful technical progress at a relevant scale, while demonstrating market traction, even though, at this scale, a prototype has little market value.
- Funding first-of-a-kind commercial projects. Traditional investors in infrastructure projects, for example, are unwilling to accept technical risk of any kind. For first of kind commercial projects, firms have two dimensions of technical risk: (a) will the product function at scale in the same way it functioned as a prototype, and (b) will the product lifespan predictions come to fruition.
- Intransigent commercial markets. Commercial markets for foundational technology are often hamstrung by two factors. First, competing with conventional industrial players that have the benefits of scale manufacturing reduces the market opportunities for startups in the sector, with associated downstream effects on the investment community that reduce incentives for investment across the innovation pipeline. Second, many of these technologies are regulated themselves or compete in regulatory environments that remain particularly intransigent to new technologies.

Already, certain agencies within the government support some of these efforts, but not at the level of funding necessary to move the needle. Moreover, without intervention by a diverse set of stakeholders, the deployment of foundational frontier tech will be socially suboptimal.

## Plan of Action

The Foundational Technology Development and Deployment Office (Office) will provide resources to coordinate and fill critical commercialization gaps for strategic technology areas. The Office should have the flexibility to use a variety of financial mechanisms depending on the stage of technological development. These mechanisms should take the form of direct grant, sub-market rate loans, loan guarantees, or tax credits, among others.

Supporting capital intensive early-stage pilot and prototype deployments for frontier tech, across industrial verticals through direct grants, is the first critical authority for the Office. There exists a notable gap in funding for capital intensive proof-of-concept pilot projects in frontier tech. These projects still maintain significant technical risk but are a necessary first step in demonstrating technology reliability, performance, and lifespan. Private sector partners are unwilling to finance this amount of technical risk. Federal grants that buy down the project cost are required for these early projects.

Second, even when proof-of-concept has been demonstrated, a given technology must scale in both size and manufacturing capacity before becoming economically competitive, however end-users/customers and financiers are reluctant to take on technical risk on a first-of-a-kind commercial project. There is an important role for government to support these projects through financial mechanisms on the periphery that incentivize and expand the pool of private sector financial intermediaries. The Office should be able to use a collection of tools to spur these types of projects:

- Direct government project acquisition. Utilize government procurement arms to finance projects on government property that serve an operational need, either within the Department of Defense or other agencies. The Office will need to work with facilities stakeholders across the country to identify and encourage these opportunities.
- Build out a Foundational Technology Loan Guarantee Program, with authorization to back-stop first-of-a-kind commercial projects across a broadly defined set of technology areas and readiness levels.
- Create an infrastructure bank that enables the government to quickly support large-scale infrastructure projects utilizing foundational technology. Importantly, the infrastructure bank needs to be structured to leverage private sector capital to cover the majority of project costs, and only public capital to support the difference between the market value of the project and the ultimate project costs. This is a critical intervention because it is rare for novel technologies to be competitive for early projects – often components/products are not yet being manufactured at scale and the corresponding projects have to compete in commodity markets.

The final important focus of the Office would be a deep commitment to workforce development and domestic manufacturing through the technological transition of the 21st century. To maximize the domestic benefits of this transition, the United States should support domestic manufacturing of new technology by developing a "scale-up ecosystem" that rivals its relative success in startup ecosystems. This accomplishes three broad goals: (1) reducing the cycle time between product and process development by reducing distance between the nexus of those efforts, (2) retaining and frontiering the country's innovation capacity by capturing the "learning by doing" that happens when scaling innovative technology, and (3) providing a source of middle-income jobs, which have in the aggregate been shrinking due to technology and global competition. To enable this, public intervention for pilot and demonstration-scale manufacturing lines is necessary. Pilot scale lines are essential for technically de-risking a technology but are not adequately developed to solicit typical private sector capital. Moreover, support for prototypes, pilots, and commercial demonstrations, at scale, are critical for locking in value-added manufacturing of new products in the United States. To that end, the Office should support:

1. Grants for development and testing of novel manufacturing processes.
2. Financing opportunities to support pilot and demonstration-at-scale manufacturing lines.
3. Development and deployment of workforce training programs associated with the technological trajectories prioritized by the Office.

## Conclusion

The next administration should create a Foundational Technology Development and Deployment Office within the Department of Commerce that retains flexible financing authority to support market-pull programs for early-stage commercialization of innovative firms. An annual $50 billion authorization, for five years, would spark nascent strategic industries, and would be critical to transitioning the U.S. workforce for the 21st century economy. The Foundational Technology Development and Deployment Office will provide resources to coordinate and fill critical commercialization gaps for strategic technology areas. With the success of such an office, the U.S. will cement itself as the global leader of frontier technology industries.

## Frequently Asked Questions

**What is the budget for this endeavor?**

$50 billion per year for five years.

**Why can't the private sector just finance these projects by raising interest rates on debt to account for the increased project risk?**

Raising the interest rate on debt would be the private sector solution. However, this does not work in commodity markets. Raising the interest rate passes through to the price of the offtake commodity from this type of project.

**Why do you think this endeavor should live in the Department of Commerce?**

The Office needs to live outside of one of the siloed industry-specific departments (Energy, Agriculture, Defense) to ensure true variance in the applications supported.

**What technology spaces should be authorized for support in the Foundational Technology and Deployment Office?**

The Office requires a wide breadth of technology areas. Rather than prescribe the specific scientific fields or industrial verticals for which this is relevant, program administrators should define the specific areas in specific solicitations. The following areas at a minimum require support:

- Quantum Computing
- Artificial Intelligence
- Synthetic Biology and Materials
- Advanced Transportation and Energy Infrastructure
- Space Exploration
- Advanced Manufacturing
- Robotics

## About the Authors

**Katie Rae** serves as the CEO & Managing Partner of The Engine, a venture capital fund built by MIT, that invests in early-stage companies solving the world's biggest problems through the convergence of breakthrough science, engineering and leadership. She serves as a Board Member at Commonwealth Fusion Systems, Form Energy, Via Separations, and Lilac Solutions. Katie has advised hundreds of founders and invested in over 100 companies. She holds an MBA from Yale and BA in Biology from Oberlin College.

**Michael Kearney** is a Senior Associate at the Engine, where he brings over a decade of operational and research experience in commercializing energy technology. Michael's background combines training in economics and systems engineering with expertise in energy technology, market development and operational experience as an entrepreneur. Michael holds a Ph.D. from MIT Sloan School of Management, where his research focused on frictions in the commercialization of science, regulatory barriers to innovation and entrepreneurial strategy. Previously, he was the 1st employee at a clean-tech startup called Ambri, where he led business development efforts for 5 years, working with customers across the United States. Michael received an M.S. in Technology and Policy from MIT and a B.A. in Mathematics and Political Science from Williams College.

**Orin Hoffman** is a Venture Partner on the investment team at The Engine. In addition to investment responsibilities, Orin leads the Engine's government affairs team which is dedicated to reducing friction for the frontier Tech ecosystem to engage with government. In this capacity, Orin serves on multiple congressional, industry, and other government initiatives. Orin was most recently a senior government civilian at the Defense Innovation Unit Experimental where he served in both investment and CTO roles. Prior to DIUx, Orin spun out and served as Chief Technologist at Endeavor Robotics, which was later acquired by FLIR systems. Orin started his career in R&D at iRobot, where he led the development and deployment of robotic systems to various disaster and conflict responses. Orin holds BA and MS degrees in physics and electrical computer engineering as well as several patents.

## About the Day One Project

**The Day One Project** is dedicated to democratizing the policymaking process by working with new and expert voices across the science and technology community, helping to develop actionable policies that can improve the lives of all Americans, and readying them for Day One of a future presidential term. For more about the Day One Project, visit dayoneproject.org.