4.

Research and Development

Research and Development Drives Environmental, Economic Progress

RESEARCH AND DEVELOPMENT

Key Takeaways:

- Research and development at the private and public levels spur scientific discoveries and technological breakthroughs to improve our knowledge base, human wellbeing, and the environment.
- Commercial breakthroughs that create jobs, drive economic growth, and reduce the risks of climate change will come from a variety of research channels.
- Removing barriers to private R&D and providing consistent expenditures for public R&D will accelerate the deployment of next generation technologies, strengthen American energy security, reduce global emissions, and strengthen the resilience of communities.

Research and development (R&D) at the private and public levels is essential to advance scientific discoveries, contribute to public knowledge, and accelerate next-generation technologies. The United States is home to Silicon Valley, some of the world's most entrepreneurial companies, world-class research facilities, and top-quality colleges and universities. R&D at these institutions and other places can deliver groundbreaking innovations and generate enormous positive economic spillovers.

THE ROLE OF RESEARCH AND DEVELOPMENT

Federal research expenditures should take on endeavors of national significance and focus on efforts that are not being undertaken by the private sector. Philip Rossetti, senior fellow at the R Street Institute, stresses that, "Public spending on R&D is most effective when complementary to the private sector, and crowding out from public spending on R&D is most likely to occur when spending is too high, as the Organization for Economic Co-operation and Development (OECD) notes that funding business R&D beyond 25 percent of costs is more likely to crowd out rather than stimulate business R&D."[1] Public R&D should be complementary to private sector investments. Granted, what research the government should undertake versus what the private sector should undertake is not always obvious. Federal agencies have provided some guidance by establishing Technology Readiness Levels (TRLs), but even so, the exact point at which commercialization is the sole responsibility of the private sector remains a gray area. [2]

Commercial breakthroughs that create jobs, drive economic growth, and reduce the risks of climate change will come from a variety of research channels and in a variety of forms. For instance, Department of Defense research for national security objectives has spawned many revolutionary commercial products such as the global positioning system (GPS) and the internet.[3] DOD's research in clean energy, whether that is solar photovoltaics, micro nuclear reactors, or battery storage, can enhance the mission capabilities of America's military while validating exciting, innovative technologies.[4] The same can be said for basic research at the Department of Energy's Office of Science.

Federal investments in clean technologies have positive economic impacts. In 2018 federal R&D directly and indirectly supported 1.6 million jobs, $126 billion in labor income, $197 billion in added economic value, and $39 billion in federal and state tax revenue.[5] In the 2023 fiscal year, the United States

In 2018 federal R&D directly and indirectly supported 1.6 million jobs, $126 billion in labor income, $197 billion in added economic value, and $39 billion in federal and state tax revenue.

will invest close to $6.6 billion across the Department of Energy's applied energy offices (Energy Efficiency and Renewable Energy, Nuclear Energy, Fossil Energy and Carbon Management, and ARPA-E). This level of funding represents a 7% to 8% increase in funding over FY22 levels. [6]

THE IMPORTANCE OF PRIVATE SECTOR R&D

From individual financiers to large corporate R&D investments, the private sector invests heavily in climate innovation research, development, and early-stage startups. For example, Earthshot Ventures launched a new venture capital fund to "invest in entrepreneurs solving climate's toughest challenges."[7] Earthshot invests in both hardware and software companies from Seed through Series B funding. The fund spun off from Elemental Excelerator and brings a team that has invested in more than 150 climate startups.[8] The proliferation of startup incubators in recent years is an exciting model that brings together innovators, entrepreneurs, and investors.[9]

According to the National Science Foundation's 2022 report on research and development trends, R&D conducted in the U.S. reached $667 billion in 2019 and an estimated $708 billion in 2020. The report notes that: "[b]usinesses are the predominant performers (75% in 2019) and funders (72%) of U.S. R&D. This sector performs most of U.S. R&D classified as experimental development, more than half of applied research, and a sizable (and increasing) share of basic research (32% in 2019)."[10]

An April 2021 report from the International Energy Agency on global trends in clean energy innovation provides more encouraging news. Patents for low-carbon energy technologies grew significantly from 2004-2014 and, after a bit of a slump from 2014-2016, climbed again from 2017-2019.[11] Importantly, the report emphasizes: "Countries are specializing nationally and collaborating internationally to foster local technology advantages."[12] Free and open markets encourage innovators in different countries to specialize, producing goods in which they have a competitive advantage. The result is greater productivity, greater trade flows, and greater deployment of a wide variety of clean energy technologies.

From individual financiers to large corporate R&D investments, the private sector invests heavily in climate innovation research, development, and early-stage startups.

FEDERAL SPENDING ON R&D

Over the past few years, the United States government has made significant commitments to next-generation technologies and demonstration projects. Congress passed the Energy Act of 2020, which packaged together many bipartisan energy and climate bills. The Energy Act authorized several research and development programs and demonstration projects for carbon capture, energy storage, and advanced geothermal. It also authorized the Advanced Reactor Demonstration Project. which will give seven awards to U.S. nuclear reactor companies: two for advanced reactor demonstrations by 2027, and five for risk reductions for future demonstrations in the early 2030s.[13]

In 2021, Congress again made big commitments for energy research and development and for next generation technologies through the Infrastructure Investment and Jobs Act (IIJA). The IIJA includes funding for direct air capture and carbon capture demonstration projects. The IIJA expanded DOE's hydrogen research program and included funding for four clean hydrogen hubs which could accelerate the commercialization and deployment of the technology. The legislation also included $3 billion for battery recycling research and development and $500 million for R&D to support greenhouse gas reductions from industrial sources.[14] The IIJA also appropriated $21.5 billion in funding to the first-year Office of Clean Energy Demonstrations.

THE FOUNDATION FOR ENERGY SECURITY AND INNOVATION AS A CONDUIT FOR INNOVATION

The CHIPS and Science Act of 2022 authorized the creation of the DOE's first agency-related foundation, the Foundation for Energy Security and Innovation (FESI).[15] FESI should be instrumental in enhancing energy security, driving environmental progress, and accelerating the commercialization of transformative technologies. More specifically, FESI can help leverage private capital and serve as a coordinator to better connect researchers, investors, and entrepreneurs. To accelerate innovation, DOE should seek the support of FESI to help accelerate what is working (effective programs, best practices, etc.) and to fix what is broken at the agency. FESI could become the work-around to many well documented frustrations of commercializing technologies from DOE spending. Those frustrations include but are not limited to stovepiped funding, inflexibility, conflict of interest laws, a culture of risk aversion (dictated by and in some cases necessary because of existing laws and regulations), budget micromanagement, weakened engagement with industry, and lack of interagency or across-agency collaboration.

Free and open markets encourage innovators in different countries to specialize, producing goods in which they have a competitive advantage. The result is greater productivity, greater trade flows, and greater deployment of a wide variety of clean energy technologies.

Due to those existing constraints, DOE could use the flexibility of FESI to help carry out its mission. DOE should also seek FESI's help in conducting a thorough audit of the agency's ability to commercialize technologies, identifying legal, regulatory, policy, and cultural barriers that create inefficiencies and include a list of fixes similar to a Government Accountability Office report. Finally, DOE could seek support from FESI in attracting private capital for investments and infrastructure that is complementary to DOE and the private sector, not overlapping.

FESI could build off existing, complementary models and programs to help accelerate energy innovation. That could include the expanded use of prizes and competitions and coordinating opportunities for demand-side, private sector procurement. Additionally, FESI could serve as a clearinghouse for information that could help industry and small businesses leverage public investment and de-risk technologies (expanding and/or learning from initiatives like the American-Made Network). Depending on funding and donation levels, several models could help accelerate the commercialization of emerging technologies.

A bold ambition would be to establish a U.S. equivalent of Germany's Fraunhofer Energy Alliance to create a sustainable model where industry utilizes research expertise in a variety of ways. This could include consortium partnerships in which rising tides lift all boats for a technology or leveraging research assets for a specific company need. The U.S. Economic Development Administration's blue economy clusters could be a useful model for certain regions and communities. The Mercatus Center's Fast Grants program could be an effective model for getting smaller chunks of money out the door quickly, which could be particularly beneficial and effective for small businesses and for inexpensive but potentially transformative technologies.

DOE and FESI's engagement should be carried out in a way that identifies gaps that the private sector is not reaching. FESI could be a coordinating force between national lab expertise and early-stage investors and philanthropic venture capital and drive more private sector funding for emergent technologies. FESI could be a market facilitator when and where DOE is not suited to deal with philanthropies and venture capitalists.

POLICY RECOMMENDATIONS TO EXPAND R&D AND INCREASE COMMERCIAL OPPORTUNITIES FOR INNOVATIVE BREAKTHROUGH TECHNOLOGIES

The U.S. has made important strides at the federal and private level to accelerate energy innovation, but policymakers can do more to capitalize on public R&D and unleash more private R&D. To accelerate R&D expenditures for breakthrough technologies, Congress and the administration should:

- **Make immediate expensing permanent and apply it to longer asset class lives and research and development.** Immediate expensing allows companies to deduct the cost of capital purchases at the time they occur rather than deducting the cost over many years based on cumbersome depreciation schedules. Without expensing, the tax code is biased against new investment; however, full and immediate expensing would incentivize investments in cleaner, more efficient technologies. After immediate expensing was implemented in the 2017 Tax Cuts and Jobs Act, private sector environmental and energy R&D jumped by $3.3 billion, or 11.8 percent in 2018.[16] At the beginning of 2023, immediate expensing provisions began the process of being phased out by 20 percent annually through 2026.

- **Reinstate and reform the research and development tax credit.** The United States is one of the most innovative countries in the world.[17] Recognizing the importance of R&D and the private sector's leadership role, Congress passed an R&D tax credit in 1981 which initially "equaled 25 percent of a corporation's research spending in excess of its average research spending in the preceding three years, or alternatively, 50 percent of its current-year spending." [18]

  After expiring in 1985, Congress reinstated an R&D tax credit that included four different types of credits: regular research, alternative simplified research, basic research, and energy research.[19] Section 174 of the tax code also allows immediate expensing of qualified research activities.[20] Businesses can expense R&D costs or use the tax credit but not both. Research has generally shown that the tax credit increased R&D spending, though to varying degrees.[21] Several documented problems have reduced the efficacy of the R&D tax credit, most notably the high compliance costs, which disproportionately affect smaller companies.[22] In fact, the beneficiaries of the tax credit have largely been big businesses, though changes through the PATH Act made the credit more accessible to small businesses by allowing "businesses with less than five years of revenues and less than $5 million in current year revenues to use the R&D tax credit to offset up to $250,000 in payroll tax liability."[23] The 2017 Tax Cuts and Jobs Act expanded the research and development tax credit to allow companies to deduct 100 percent of their R&D costs in the year that they occurred. Congress failed to extend the tax credits' provisions in the 2022 omnibus, which now means that companies are required to amortize domestic and foreign R&D expenditures over a 5 and 15 year period, respectively.[24] Congress should reinstate and reform the R&D tax credit. Ways to simplify and improve the R&D tax credit and expand opportunities for small businesses include:

    - Harmonizing the definition of research expenditures for the R&D tax credit and for R&D expensing.
    - Eliminating the regular credit and replacing it with a modified alternative simplified credit. [25]
    - Raising the payroll tax liability that can be offset from the R&D credit to benefit small businesses and startups.
    - Expanding eligibility for startups and new businesses by raising the gross receipts threshold. [26]

- **Maintain support and continue to fund key programs at the Department of Energy.** Programs such as ARPA-E, the Advanced Reactor Demonstration Program (ARDP), the Milestone-based Fusion Development Program, and others have yielded significant developments for clean energy technologies and play a pivotal role in advancing early-stage technologies that would otherwise not be profitable.

- **Provide strong oversight on R&D spending.** The IIJA authorized over $73 billion in new funding for clean energy projects[27] while the IRA authorized nearly $400 billion[28] to advance clean energy technologies, albeit mostly through subsidies and tax credits. The CHIPS and Science Act also authorized substantial funding for research and development and workforce training programs.[29] Given the high level of funding that all three of these bills authorized and will receive over the coming years, Congress must make sure that federal spending is properly allocated and not subject to fraud and abuse or is duplicative of private sector efforts. To get the most public good and energy innovation out of these bills as possible, efficient and honest spending–as well as effective permitting reform–must occur.

ENDNOTES

1 Philip Rossetti, "The Effects of the Tax Reform on Energy and Environmental Research and Development," R Street Institute, R Street Shorts No. 103, May 2021, https://www.rstreet.org/wp-content/uploads/2021/05/Final-Short-103.pdf

2 National Energy Technology Laboratory, "DOE Technology Readiness Levels," U.S. Department of Energy, https://netl.doe.gov/coal/rare-earth-elements/program-overview/definitions

3 Matthew Step et al., "Turning the Page: Reimagining the National Labs in the 21st Century Innovation Economy," Information Technology and Innovation Foundation, June 2013, https://www2.itif.org/2013-turning-page-national-lab-innovation-economy.pdf

4 Dorothy Robyn and Jeffrey Marqusee, "The Clean Energy Dividend: Military Investment in Energy Technology and What It Means for Civilian Energy Innovation," Information Technology and Innovation Foundation, March 2018, http://www2.itif.org/2019-clean-energy-dividend.pdf?_ga=2.133613257.674204463.1551967655-1212308.1551734962

5 Breakthrough Energy. "Impacts of Federal R&D Investment on the U.S. Economy." September 2020. https://breakthroughenergy.org/wp-content/uploads/2022/10/BEPwCReport09162020.pdf

6 American Institute of Physics, "FY23 Budget Outcomes: DOE Applied Energy R&D," March 3, 2023, https://www.aip.org/fyi/2023/fy23-budget-outcomes-doe-applied-energy-rd. "Energy Innovation in the Federal Budget." March 28, 2022. https://itif.org/publications/2022/03/28/energizing-innovation-fy-2022-interactive-dataviz

7 Earthshot Ventures, "Our Story," https://www.earthshot.vc/about

8 Press release, "Elemental Excelerator Unveils Earthshot Ventures, a New Climate Technology Fund," PR Newswire, September 8, 2021, https://www.prnewswire.com/news-releases/elemental-excelerator-unveils-earthshot-ventures-a-new-climate-technology-fund-301370955.html

9 Several climate-specific ventures have emerged in recent years, too, including Congruent Ventures, Energy Impact Partners and Greentown Labs. Perhaps the most well-known is Bill Gates-led Breakthrough Energy Ventures. In January, Breakthrough announced it raised its second round of $1 billion that will fund approximately 40-50 climate-focused start-ups.

10 National Science Foundation, "Research and Development: U.S. Trends and International Comparisons," 2022, https://ncses.nsf.gov/pubs/nsb20225/executive-summary

11 International Energy Agency, "Patents and the energy transition Global trends in clean energy technology innovation," April 2021, https://iea.blob.core.windows.net/assets/d14427c6-2aa2-4422-9074-5a68940a5a96/Patents_and_the_energy_transition_-_keyfindings.pdf

12 Ibid.

13 Rich Powell, Mitch Kersey, and Spencer Nelson. "The Energy Act of 2020: A Monumental Climate and Clean Energy Bill." ClearPath, April 1, 2021. https://clearpath.org/our-take/the-energy-act-of-2020-a-monumental-climate-and-clean-energy-bill/

14 Eric L. Christensen, James M. Auslander, and Zachary B. Pilchen. "The Bipartisan Infrastructure Package: What it Means for Energy and Climate." The National Law Review, November 16, 2021.

15 Press Release, "DOE Launches Foundation for Energy Security and Innovation," Department of Energy, February 9, 2023, https://www.energy.gov/articles/doe-launches-foundation-energy-security-and-innovation

16 Philip Rossetti, "The Effects of the Tax Reform on Energy and Environmental Research and Development," R Street Institute, R Street Shorts No. 103, May 2021, https://www.rstreet.org/wp-content/uploads/2021/05/Final-Short-103.pdf

17 The Bloomberg Innovation Index, https://www.bloomberg.com/graphics/2015-innovative-countries/

18 Alex Muresianu and Garrett Watson, "Reviewing the Federal Tax Treatment of Research & Development Expenses," Tax Foundation, April 13, 2021, https://taxfoundation.org/research-and-development-tax/#Spending

19 Legal Information Institute, "26 U.S. Code § 41 - Credit for increasing research activities," Cornell Law School, https://www.law.cornell.edu/uscode/text/26/41

20 Ibid

21 For a literature review of the economic effects, see Alex Muresianu and Garrett Watson, "Reviewing the Federal Tax Treatment of Research & Development Expenses," Tax Foundation, April 13, 2021, https://taxfoundation.org/research-and-development-tax/#Spending

22 Ibid.

23 Ibid.

24 Jeff Luse, "Pro-growth tax policies can spur innovation, bolster domestic energy security," The Hill, January 15, 2023, https://thehill.com/opinion/finance/3814457-pro-growth-tax-policies-can-spur-innovation-bolster-domestic-energy-security/

25 U.S. Government Accountability Office, "Tax Policy: The Research Tax Credit's Design and Administration Can Be Improved," November 2009, https://www.gao.gov/products/gao-10-136

26 The last two recommendations come from the American Innovation and Jobs Act. See, S.4822 - American Innovation and Jobs Act, https://www.congress.gov/bill/116th-congress/senate-bill/4822/titles

27 BGR Group, "Infrastructure Investment and Jobs Act – Power and Energy," https://bgrdc.com/infrastructure-investment-and-jobs-act-power-and-energy/

28 Justin Badlam et al, "The Inflation Reduction Act: Here's what's in it," McKinsey & Company, October 24, 2022, https://www.mckinsey.com/industries/public-and-social-sector/our-insights/the-inflation-reduction-act-heres-whats-in-it

29 Mariana Ambrose, John Jacobs, and Natalie Tham, "CHIPS and Science Act Summary: Energy, Climate, and Science Provisions," Bipartisan Policy Center, November 14, 2022, https://bipartisanpolicy.org/blog/chips-science-act-summary/