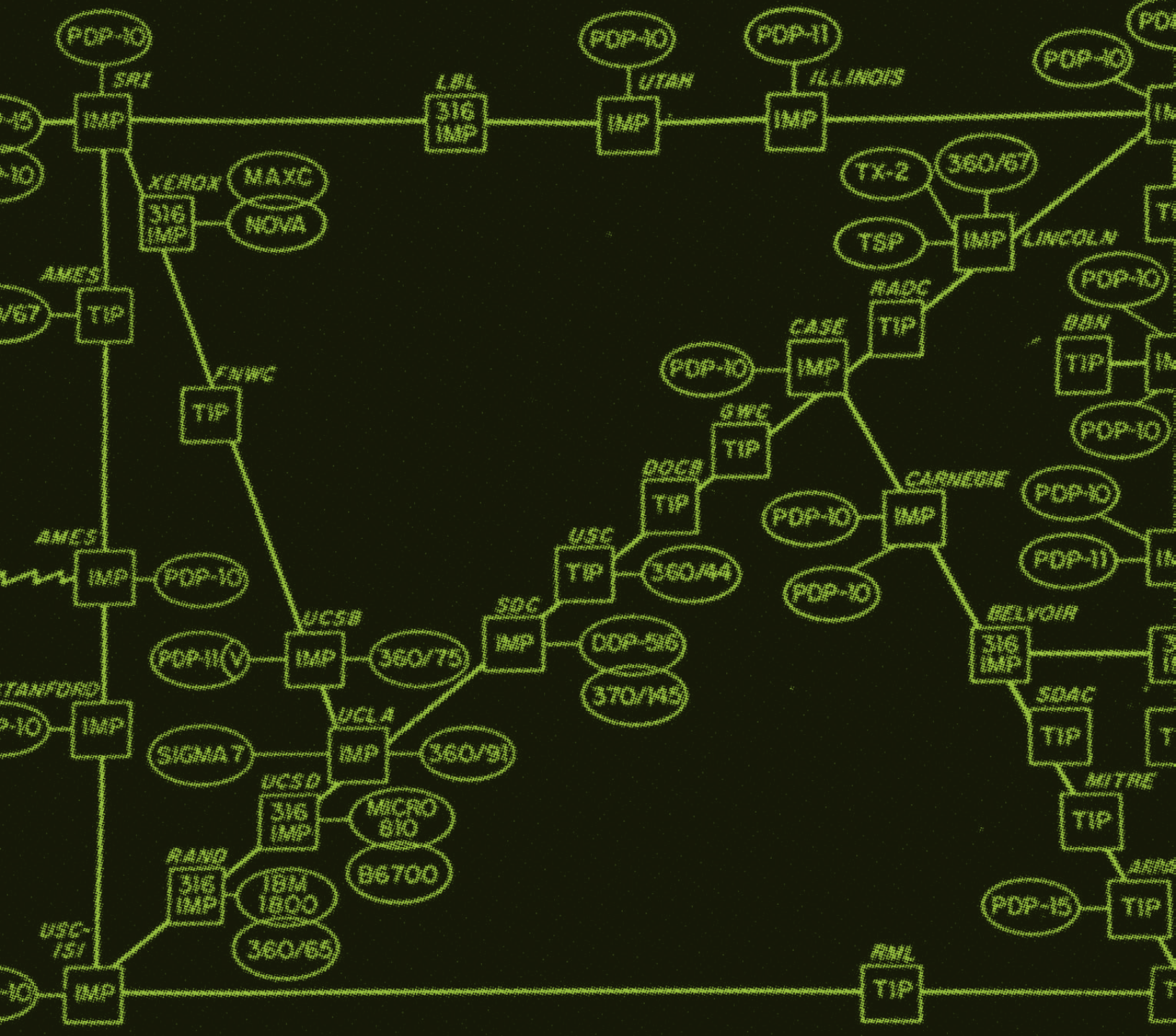
an INNOVATION POLICY for the GREEN NEW DEAL

DAN TRAFICONTE
IAN WELLS

PEOPLE'S POLICY PROJECT

ARPA NETWORK, LOGICAL MAP, MAY 1973



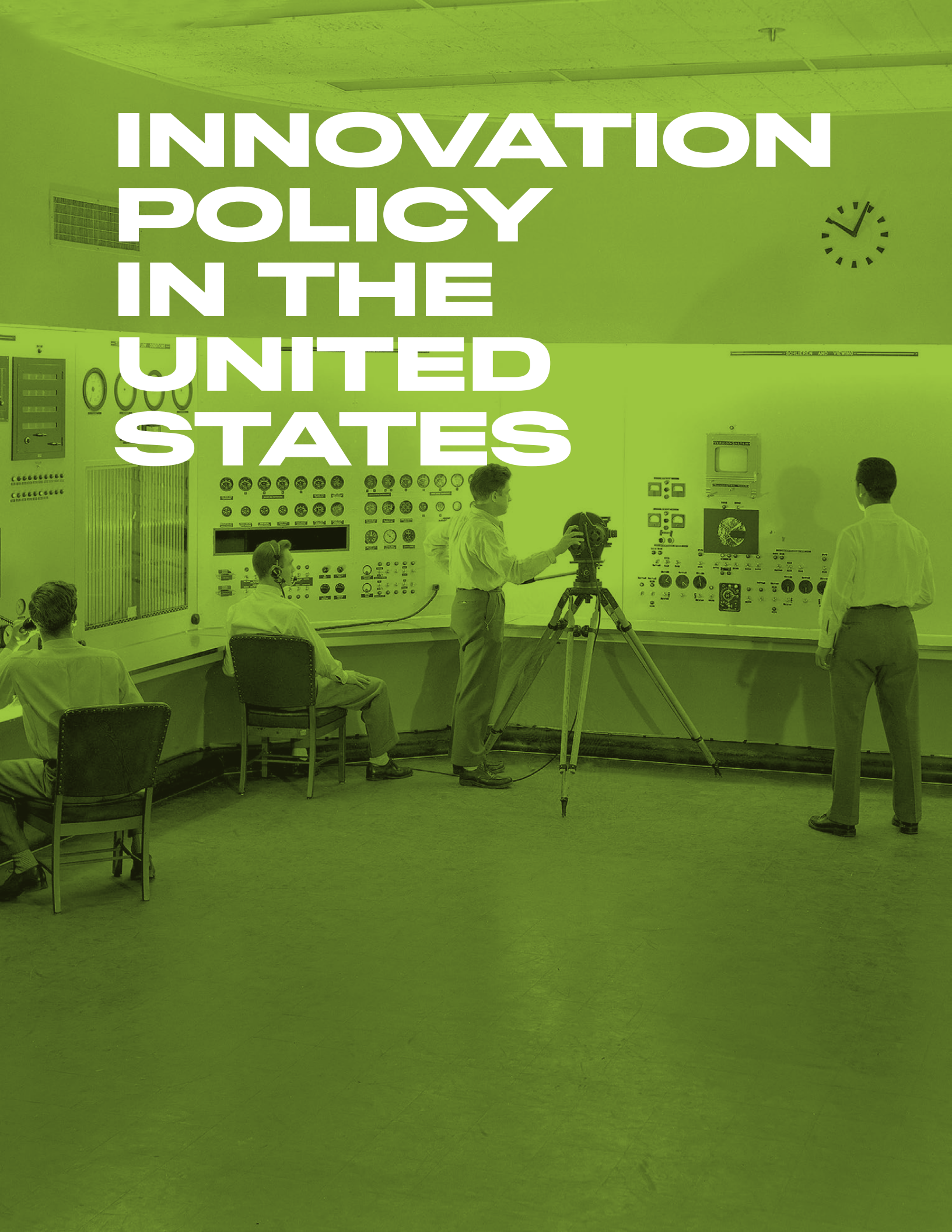
The Green New Deal, a proposal introduced by Rep. Alexandria Ocasio-Cortez and Sen. Ed Markey, marks new hope in the fight against climate change and a major opportunity for progressive economic reform. Most of the goals outlined in the proposal involve investments in infrastructure and already-existing green technologies, but the Green New Deal also calls for new innovations—for "public investments in the research and development of new clean and renewable energy technologies and industries."[1] This is a call for a new R&D-led innovation policy in the United States.

In this paper we outline a new public R&D strategy that can help achieve a more sustainable environment and a more equitable economy. To that end, we argue that existing federal innovation programs and capacities should be reoriented toward green technology and scaled up significantly. Additionally, we suggest changes to the existing federal innovation system that would increase public ownership and control over the economic gains generated by publicly-funded innovation programs. In brief, we propose:

1. Radically upscaling the Department of Energy's ARPA-E program, and launching a major carbon capture project within that program.
2. Creating a national network of Green New Deal Institutes, which can serve as consortia for industry and university researchers to coordinate research efforts toward particular goals.
3. Consolidating and reorienting the federal government's venture capital activities toward green technology startups.
4. Creating a Green Innovation Fund for investments in green technology, financed in part by revenue from ownership stakes in intellectual property generated by publicly-funded technology programs; interest from loans made to green technology firms; and returns from the government's equity shares in green technology firms.

Together, these reforms would redirect the federal R&D system to produce technology necessary for a carbon-negative economy while ensuring that the economic gains generated by publicly-financed technology are more equitably distributed.

INNOVATION POLICY IN THE UNITED STATES



The American economy derives much of its capacity for innovation from government intervention. Since World War II, the federal government has played a foundational role in promoting new, economically transformational innovations through basic and applied research. The Internet is one obvious example: though later developments came from the private sector, its origins lie in the Department of Defense's ARPANET project in the late 1960s. Nearly all of the components of the iPhone, as the economist Mariana Mazzucato has demonstrated, can be traced back to technology programs funded by the US government.[2]

The standard justification for this kind of intervention is based on the concept of "market failure": at critical points of the product innovation cycle, the financial risk is too high and the current market demand too limited to justify major private investments. Here, the government must step in and provide R&D support in order to sustain technological innovation.[3]

Such interventions are also warranted when the social benefits of certain innovations outweigh the gains internalized by individual private firms.[4] Green technologies are a paradigm case of this, because their social benefits are extremely diffuse. Thus, some advocates of innovation policy have pushed beyond the market failure rationale and suggested that the government should create new markets and intentionally alter the direction of technological innovation for broader social ends, the fight against climate change being one of them.[5]

Today, the innovation activities of the federal government emerge from a complex array of programs scattered throughout executive branch agencies, in particular the military. These programs perform a variety of different functions, each connected to some part of the

innovation process. Three of these types of programs are particularly relevant for Green New Deal innovation policy.

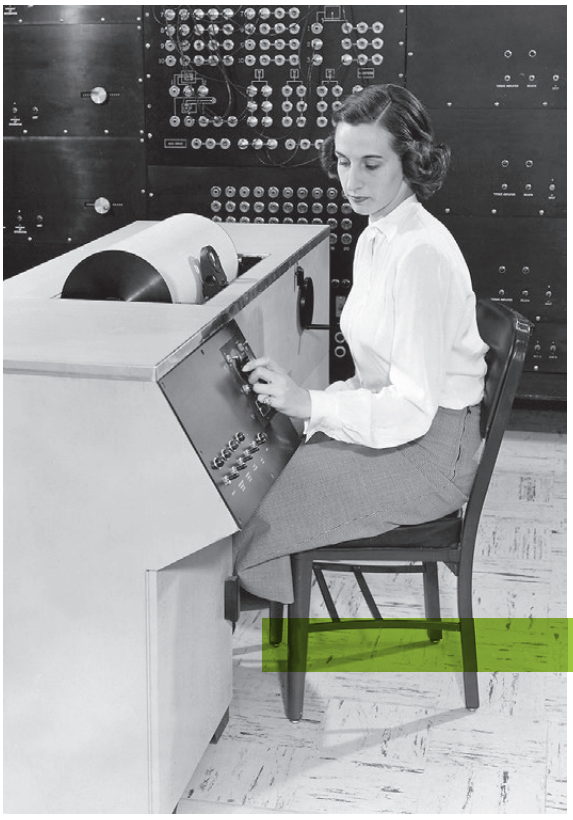
First, the government owns and operates a series of state laboratories, research centers, and agencies—including the **Defense Advanced Research Projects Agency** (DARPA) and Sandia National Labs—that directly create or fund the creation of new technologies.

Second, the government organizes and funds industry-specific consortia through which firms can collaborate on research and development projects subsidized by government funding. An example of this approach is the SEMATECH program of the late 1980s and early 90s, which aimed to revitalize the American semiconductor industry.

And third, the government provides venture capital funding to innovative startup firms in the form of low-interest loans and grants. One example is the **Small Business Innovation Research** (SBIR) program, which has provided startup capital to a number of now-successful companies, including Apple and Qualcomm.[6]

From a progressive perspective, there are three basic problems with the federal government's current approach to innovation policy. First, current innovation policy does not prioritize green and sustainable technologies. Despite some efforts by the Obama Administration to push for green innovation, the current system is still overwhelmingly devoted to military and healthcare-related technologies. Second, the current system is built on an unfair arrangement for the public: government innovation programs tend to channel public investments into private hands for commercialization without enough direct public reimbursement. It socializes risk and privatizes gain. Finally, contemporary innovation policy tends to concentrate economic gains in particular geographic areas, many of which are already thriving. In many cases, the government's innovation programs support institutions and firms in high-tech clusters like Silicon Valley in California and Route 128 in Massachusetts, but do very little for lagging regions in need of new industrial bases.

We propose that federal innovation policy be radically shifted to prioritize green technology development, to increase the government's ownership stakes and control rights over the fruits of green technology programs, and to serve, in conjunction with other Green New Deal investment programs, goals of regional development.

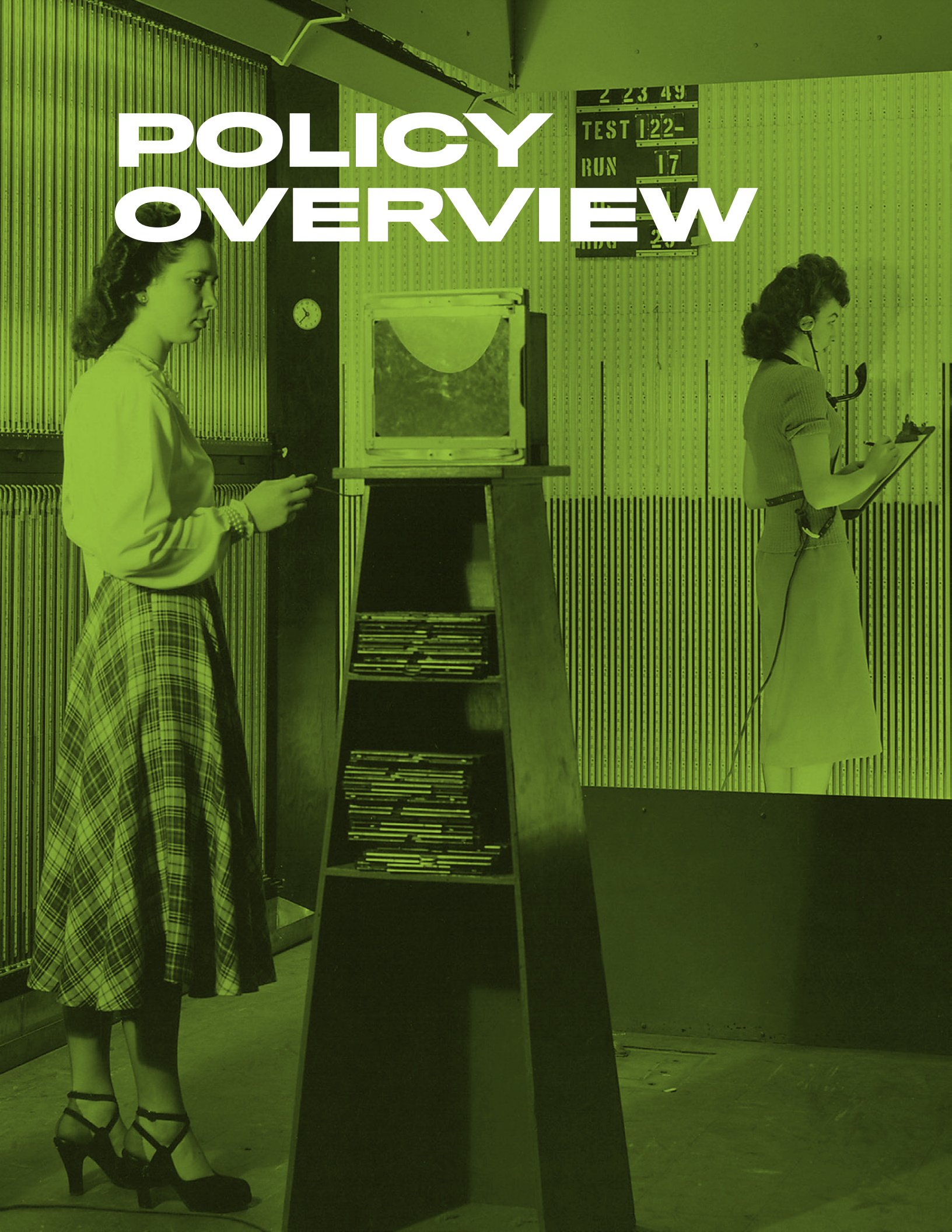


FROM THE NEW DEAL TO THE GREEN NEW DEAL

THIS APPROACH TO R&D POLICY HAS ROOTS in the progressive traditions of the Democratic Party, and stretches back to the final years of the Roosevelt era. During World War II, the federal government dramatically expanded its efforts to foster technological innovation, creating a number of federal labs and mobilizing investments for the rapid development of war-related technologies.

After the war, lawmakers from the progressive wing of the Democratic Party, led by Senator Harley Kilgore, proposed to extend these efforts in keeping with New Deal policy aims. They held that technology programs were a new form of social policy, and proposed that the government should plan and direct innovation to serve broad social goals and regional development. Kilgore and his colleagues also wanted the government to retain its ownership stakes over the results of these programs, since they were funded by the public in the first place.[7]

This progressive vision for federal innovation policy eventually lost out, however, to an alternative supported by conservatives in Congress and business groups. They resisted the idea that technology programs could be democratically controlled and oriented toward particular social goals, and preferred a more decentralized and fragmented set of programs that they could more easily coopt.[8] The Kilgore vision of a coordinated and socially-oriented technology policy has never been fully revived despite some attempts by progressive Democrats in the following decades.[9] The Green New Deal represents a promising opportunity to return to this progressive vision.



POLICY OVERVIEW

As part of the Green New Deal, the federal government should mobilize its innovation capacities to serve the twin goals of green technology development and economic and social justice. We propose four core components for the Green New Deal's investments in new technologies: Congress should pass a "green technology mobilization" bill that 1 radically upscales the ARPA-E program, and includes a major carbon capture technology program funded by ARPA-E; 2 creates a nationwide network of "Green New Deal Institutes" devoted to developing particular subareas of green technologies and sustainable manufacturing, strategically located in economically lagging areas; 3 consolidates and reorients the federal government's venture capital activities toward sustainability-related firms in which the government retains equity shares; and 4 creates a "Green Innovation Fund," funded by royalties from government-owned IP, interest from government loans, and dividends from government equity stakes, which is used to fund further investments.

SCALE UP ARPA-E

AND LAUNCH A MAJOR

CARBON CAPTURE PROJECT

The first of our proposal's four core components channels federal funding toward "blue sky" innovation projects that are not near a point where they can be commercialized. The government has been directly funding blue sky innovation for decades, beginning with the creation of DARPA in 1958 following the USSR's Sputnik launch. DARPA, in turn, has developed proto-versions of a number of new technologies, including the Internet, stealth technology, and self-driving cars.[10] DARPA's focus, however, is on security-related technologies, and its mandate prevents the agency from investing heavily in green technologies.

Another program is a better fit for the Green New Deal: the **Advanced Research Projects Agency-Energy** (ARPA-E), greenlit by the Bush Administration in 2007. Based in the Department of Energy and modeled closely after DARPA, ARPA-E was created in response to a growing perception that the US was lagging behind in energy-related technological innovation. The Obama Administration provided ARPA-E with its first budget in 2009 as part of that year's economic stimulus bill.[11]

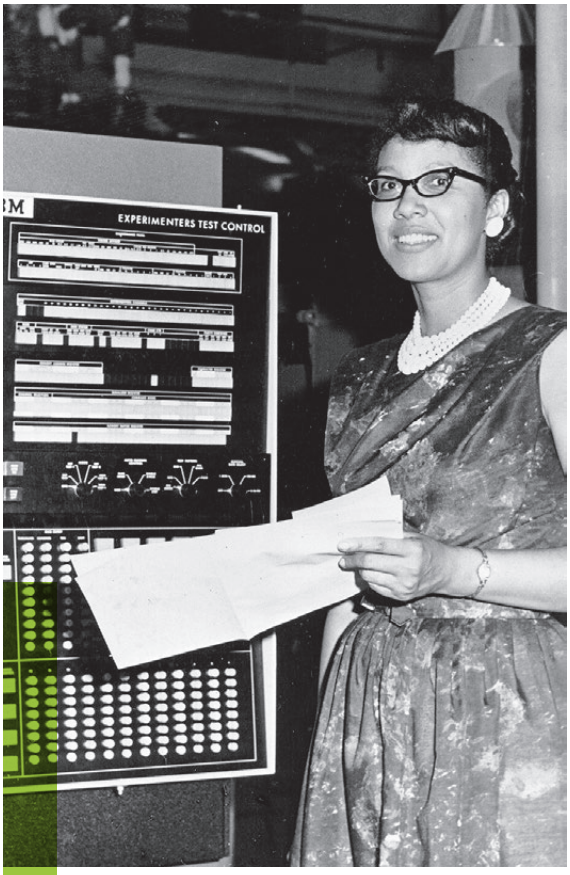
Like DARPA, ARPA-E's mandate is to fund research projects for high-risk, early-stage technologies. These projects are usually carried

out by government labs, universities, and labs at private firms. In its nearly ten years of operations, ARPA-E has carried out 660 separate research projects with $1.8 billion in funding. These projects have generated 245 new patents and 71 spinoff startup companies based on the technologies generated.[12]

ARPA-E is a promising vehicle for a new focus on high-risk R&D for the Green New Deal, but it should be scaled up dramatically given the urgency of the climate threat. ARPA-E's annual budget in 2017 was $306 million; in comparison, DARPA's annual budget for that same year was nearly $3 billion.[13] In early 2017, the Trump Administration proposed eliminating ARPA-E's budget entirely in its annual budget request while increasing DARPA funds.[14] A progressive response would draw down DARPA's funding while substantially increasing ARPA-E's funding to the point where the latter receives as much or more funding than DARPA.

This investment in ARPA-E should be launched in conjunction with a new program focused on carbon capture and sequestration (CCS) technology. CCS removes CO_2 from the atmosphere, and comes in two basic forms: it can be either point source, which involves capturing carbon from the site of a large CO_2 emitter, or direct air capture, which involves capturing carbon from ambient air.[15]

Point source methods at fossil fuel fired power plants can, at best, maintain carbon neutral emissions at sites that use fossil fuels—but many programs have emphasized this application of CCS over direct air capture.[16] We suggest that ARPA-E sponsor a new large- scale project focused primarily on direct air capture and bioenergy with carbon capture and storage. Breakthroughs in this carbon-negative technology could represent a major step forward in not only mitigating climate change but in fundamentally reversing it. A major CCS project could also capture the imagination of the public and serve as a rallying call for the Green New Deal.



ESTABLISH A NATIONAL NETWORK OF

GREEN NEW DEAL INSTITUTES

THE SECOND CORE COMPONENT AIMS TO support green technologies that are more developed and relatively close to commercialization. To that end, we propose that the federal government fund a series of industry consortia, which we call **Green New Deal Institutes**, that would incentivize firms competing in the same technological fields to collaborate on research and development projects and share firm-specific know-how. These consortia can also bring together university research partners.

This consortium-based strategy is a good fit for green technologies that suffer from development bottlenecks due to the fragmentation of intellectual property and know-how between competing firms. It would also provide an overarching coordinating mechanism that would spur them to collaborate, allowing the government to actively direct industry-stage research projects by charting out an innovation roadmap for each technological area and sponsoring particular research projects.

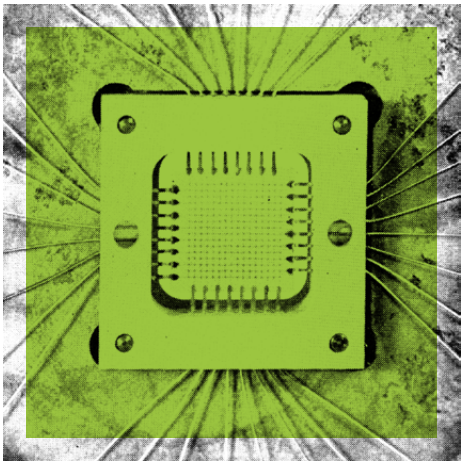
One Green New Deal Institute that could be established, for example, would focus specifically on battery storage technology. It would construct a government-owned research facility that firms and university researchers could use to carry out projects. The institute would encourage collaboration by:

1. Subsidizing the research projects by funding two-thirds of their costs, with the rest of the costs borne by participating firms;

2. Assessing the know-how and research needs and interests of these different private actors, and coordinating them into research teams; and

3. Constructing a technology roadmap that lays out specific research goals that can be pursued on a project-by-project basis.

The government would fund this institute for 10 years, after which point, and if it is still useful, the consortium could become self-sustaining based on membership fees alone.



An inspirational model for this project is the German **Fraunhofer Society**, a large network of 72 institutes spread across Germany, with some institute branches in the US as well. In this system, each Fraunhofer Institute focuses on a separate area of applied research and development, bringing together firms and university researchers working in that area to collaborate on research projects.[17] Observers have often pointed to the Fraunhofer Society as a key element in ensuring Germany's global dominance in high-end manufacturing. This model could do the same for the US in the area of green technologies.

There is precedent for this approach in the United States as well. In the late 1980s, when the American semiconductor industry was severely lagging behind Japan's, the federal government sponsored **SEMATECH**, a national consortium of US-based semiconductor producers that focused primarily on inter-firm collaboration. With funding from the federal government and industry, SEMATECH constructed a major research facility and pooled together the expertise of member firms to achieve rapid advances in semiconductor manufacturing. By the early 90s, US chip manufacturers had regained the global competitive edge.[18]

Similarly, in 2012 the Obama Administration launched the **Manufacturing USA** program, a series of 14 consortia across the nation, each oriented toward a distinct area of advanced manufacturing.[19] The federal government's experience with consortium-based technology promotion could inform the creation of the Green New Deal Institutes.

We suggest that these Institutes, in conjunction with other Green New Deal programs, should be established to serve regional development goals for areas that are economically lagging and in need of new industrial bases. For example, though many of the Manufacturing USA consortia were established in major economic hubs like Boston and Los Angeles, the first of Manufacturing USA's innovation institute was established in Youngstown, Ohio with an explicit aim of spurring economic recovery in that postindustrial city.[20] This should be a core part of the strategy behind the Green New Deal Institutes.

MOBILIZE PUBLIC VENTURE CAPITAL

The third core component aims to support the near-term deployment of market-ready technologies by funding green technology startups through government-owned equity. Again, this is largely something the government is already doing: through a number of distinct channels, including the SBIR program, the Defense Venture Catalyst Initiative, In-Q-Tel, and others, the federal government is actively involved in providing startup funding for private firms judged to be of particular value to certain objectives, usually pertaining to national security.[21] We propose that the federal government consolidate and redirect its venture capital activities toward green energy startups and establish a new major venture capital fund to focus exclusively on green technology firms.

The Obama Administration proposed a version of this idea, called the **ARPA-E Trust,** that would have established such a fund within the ARPA-E program. Sustainable and green technologies are consistently under-funded by private venture capital, a result of the high-risk nature of these investments and the long time horizon for a payoff. This is where the government can and should step in to direct investment. Unlike other public startup funds,

which usually provide low-interest loans,[22] this new venture capital fund should fund startups by buying equity stakes in startups.

These kinds of venture-based activities of the federal government have been criticized, as with any effort to promote technological development in key sectors, as prone to capture by political interests. Critics point in particular to the Obama Administration's funding of Solyndra, a solar energy startup that went into bankruptcy not long after receiving a multi-hundred million dollar loan from the federal government. But as with any private system of venture capital, the failure of some investments is to be expected. If some investments did not fail, it would indicate that the government is not taking appropriate risks in pushing forward new technology.[23]

MAY 1975 John Bayliss, president of the Solaron Corporation, the first publicly owned solar energy company in the nation.

U.S. NATIONAL ARCHIVES

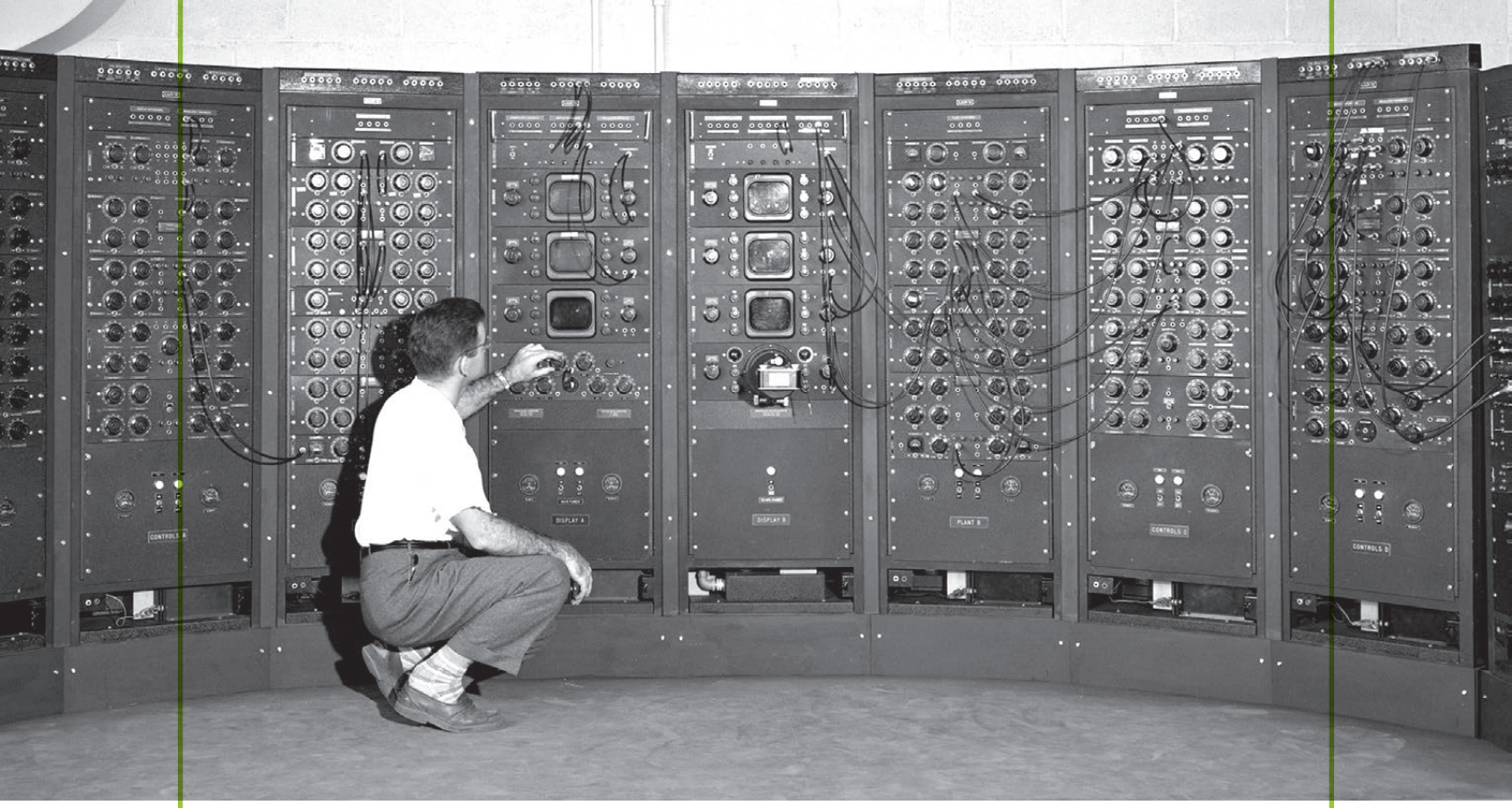
CREATE A GREEN INNOVATION FUND

To manage investments made in green technology, Congress should approve the creation and initial financing of a Green Innovation Fund that will create a portfolio of investments in R&D and green technology firms.

I. REVOLVING FUNDING FOR A GREEN INNOVATION FUND

The programs described above could make sustained funding of a Green Innovation Fund easier: the revenues from publically-generated intellectual property and equity shares in successful publicly-backed firms can be channeled back into the Green Innovation Fund, which could then be tapped for further funding of new projects. Additionally, the Green Innovation Fund could be channeled into other social spending programs, which would democratize the gains from public investment in these technologies.

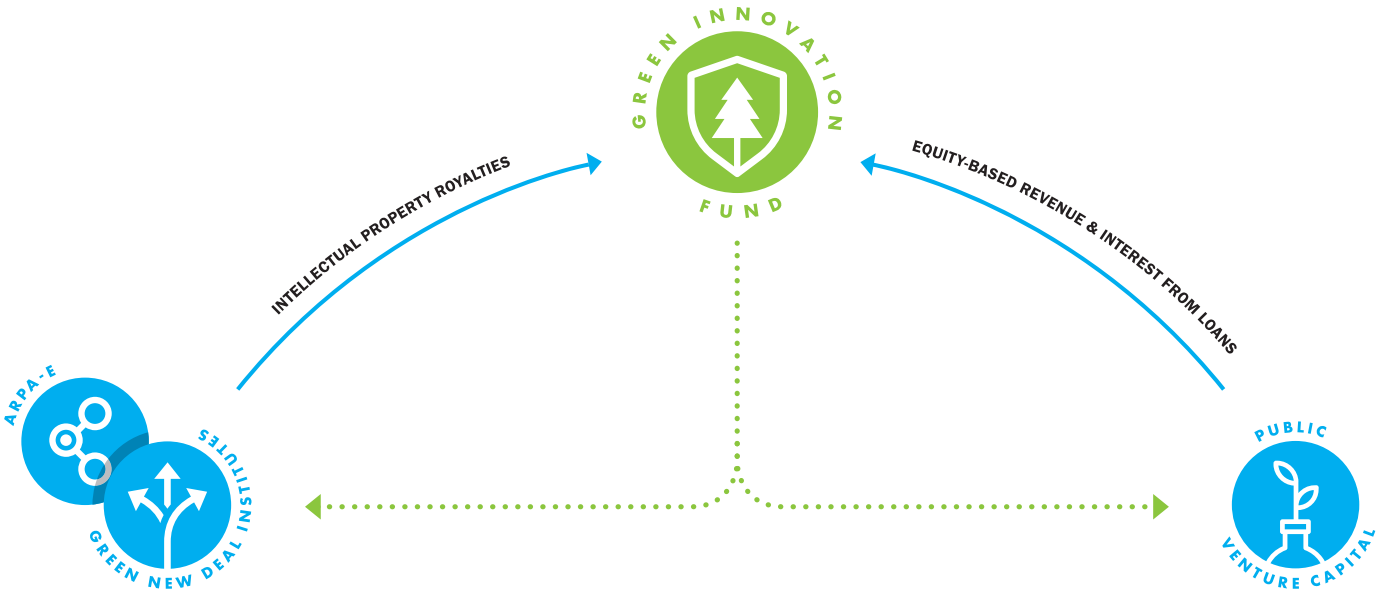
Generating revenue through public ownership of IP rights or equity in firms is particularly important given the faults of the current method employed by the federal gov-



ernment to receive returns from investment in innovation: taxation. Technology firms have demonstrated a remarkable ability to avoid federal taxation in the US. Apple notoriously shelters earnings in low tax nations like Ireland, and this year, Amazon will reportedly pay no federal taxes.[24] Alternative revenue sources are needed if the federal government is going to be able to capture a fair share of gains from technology it helped produce.

To secure revolving financing for a Green Innovation Fund, ARPA-E's operational policies should be amended to ensure that the federal government retains ownership over the intellectual property resulting from ARPA-E-sponsored projects. Under the current policy, intellectual property resulting from government-backed projects is handed over to the private sector partners, usually private firms or university researchers hoping to spin their research off into startups.[25] The government often retains "march in rights" that allow it to use that intellectual property in exceptional or emergency cases—but if that intellectual property is commercialized, the government does not receive any of the revenue. We suggest that ARPA-E adjust its intellectual property policies and retain its right to royalty fees for the commercial use of technologies the public has invested in.[26] This would resocialize some portion of the gains from these projects back into the public sphere, creating a more equitable system than the current one.

The federal government should also retain its rights to royalty fees for commercial use of intellectual property resulting from Green New Deal Institutes. Since this program would be geared toward technologies closer



to commercialization, this could potentially result in revenue faster than ARPA-E projects, which might take a longer time to reach the market.

Along with any venture capital investments in green technology firms, the federal government should implement reforms to ensure it is generating a return on its investments that reflects early-stage risks. One such reform, as noted in Section 3, would be to take an equity stake in any early-stage startup to which the government loans money. In successful cases, this would give the government an opportunity to raise back much more than its initial high-risk investment.

Consider, for example, the case of **Tesla**—a company that received a low-interest loan of $465 million from the Advanced Technology Vehicle Manufacturing Program, which was a fund set up as part of the automotive bailout of 2008. This loan allowed Tesla to construct a new production facility in California and begin work on its new Model S just months before going public. Tesla repaid its loan in only three years, nine years ahead of the repayment deadline.[27] Had the government taken an equity stake in Tesla instead of issuing a low-interest loan, the public revenue generated by the investment would have been massive.[28]

The government should build up its own portfolio of ownership shares in a number of green technology startups. In some circumstances, the government may have sufficient leverage to promote progressive corporate governance arrangements at these startups, including worker representation on boards and cooperative ownership structures.

II.
THE GREEN INNOVATION FUND AND ECONOMIC DEMOCRACY

The Green Innovation Fund should be operated in a way that promotes economic democracy—increased public input over the functioning of private industry. To this end, we propose two reforms.

First, the federal government should include conditions on any funding assistance to private companies. For example, as part of a debt or equity investment in a green technology firm, the government can mandate that the firm pay all workers a living wage, create mandatory seats for worker and government representation on the firm's board or limit the ability to engage in stock buybacks. In line with the goals of the Green New Deal, such conditions might also include requirements to use clean energy in the firm's operations.

Second, when the federal government takes an equity stake in a company, it should use its position as a partial owner of the firm to shape how the firm is managed. Depending on the governance structure of the firm, this might include using voting status as a shareholder or member. As the firm continues operations, the federal government would retain an ability to shape the decisions of the firm and forward the policy goals of the Green New Deal.

CONCLUSION

The federal government has achieved remarkable technological advances through publicly-funded R&D in previous times of national crises, including World War II. Climate change is perhaps the greatest threat this country has ever faced. The government's R&D capacities should play a key role in combating this threat, and should be a major component of the new movement for a Green New Deal.

NOTES

1 (4)(D) of Congresswoman Ocasio-Cortez's draft resolution. https://www.vox.com/2019/2/7/18215290/alexandria-ocasio-cortez-ed-markey-green-new-deal

2 Mariana Mazzucato (2013). The Entrepreneurial State. Anthem Press. For the discussion of the origins of the iPhone, see Chapter 5, "The State behind the iPhone," pp. 87-112.

3 See Mazzucato 2013, "Beyond Market Failure" at page 28.

4 This justification for publicly funded R&D goes back arguments developed by Kenneth Arrow in 1962. Arrow, K. J. (1962). 'Economic welfare and the allocation of resources for invention,' in (R. R. Nelson, ed.) The Rate and Direction of Inventive Activity. Princeton: Princeton University Press.

5 Mazzucato, footnote 3.

6 See generally Eds. Fred Block and Matthew R. Keller (2011), State of Innovation: The US Government's Role in Technology Development. Routledge.

7 Daniel Lee Kleinman (1992) Politics on the Endless Frontier: Postwar Research Policy in the United States. Chapter 4, "Harley Kilgore and a New Deal for Research" pp. 76-92. Duke University Press.

8 See Kleinman note 7, Chapter 4, "Science—The Endless Frontier: Bush and Best Science" pp. 92-99.

9 On efforts to consolidate and coordinate federal industrial policy programs in the early 1980s, see generally Otis Graham (1992) Losing Time: The Industrial Policy Debate. Harvard University Press.

10 Sharon Weinberger (2017). The Imagineers of War: The Untold Story of DARPA, the Pentagon Agency that Changed the World. Knopf.

11 David M. Hart and Michael Kearney (2017). "ARPA-E: Versatile Catalyst for U.S. Energy Innovation."

12 ARPA-E Website. "ARPA-E Impact." https://arpa-e.energy.gov/?q=site-page/arpa-e-impact

13 FY19 Budget Request: Defense S&T Stable as DOD Focuses on Technology Transition. https://www.aip.org/fyi/2018/fy19-budget-request-defense-st-stable-dod-focuses-technology-transition

14 William B. Bonvillian (2017). "ARPA-E on the Chopping Block." The American Interest.

15 Peter Folger (2018). "Carbon Capture and Sequestration (CCS) in the United States." Congressional Research Service.

16 See. e.g., Dep't of Energy (2018) "Department of Energy Announces $30 Million for Transformational Carbon Capture Technologies." (describing a funding opportunity for projects that support "DOE's goal to develop technologies that can significantly reduce the cost of CO2 capture from coal fired power plants.") availiable at https://www.energy.gov/articles/department-energy-announces-30-million-transformational-carbon-capture-technologies

17 "About Fraunhofer." https://www.fraunhofer.de/en/about-fraunhofer.html

18 Robert D. Hof (2011). "Lessons from Sematech." MIT Technology Review. https://www.technologyreview.com/s/424786/lessons-from-sematech/

19 William B. Bonvillian and Peter L. Singer (2018). Advanced Manufacturing: The New American Innovation Policies. MIT Press.

20 White House Press Release, August 16, 2012. https://obamawhitehouse.archives.gov/the-press-office/2012/08/16/we-can-t-wait-obama-administration-announces-new-public-private-partners

21 SBIR: https://www.sbir.gov/about/about-sbir; Defense Venture Catalyst Initiative: https://www.reuters.com/article/venture-pentagon/pentagon-turns-to-silicon-valley-for-leads-idUSN1E79C21O20111014

In-Q-Tel: https://www.iqt.org/how-we-work/

22 One exception is the CIA's venture capital fund, In-Q-Tel, which spends approximately 15 percent of its budget allocation on equity investments. Matthew R. Keller (2011). "The CIA's Pioneering Role in Public Venture Capital Initiatives." from State of Innovation: The US Government's Role in Technology Development. Eds. Block and Keller.

23 For a discussion of the Solyndra case see Dani Rodrik, "Green Industrial Policy." Oxford Review of Economic Policy, Volume 30, Number 3, 2014, pp. 469–491.

24 Christopher Ingraham, "Amazon paid no federal taxes on $11.2 billion in profits last year." Feb. 16, 2019. The Washington Post. available at https://www.washingtonpost.com/us-policy/2019/02/16/amazon-paid-no-federal-taxes-billion-profits-last-year/?noredirect=on&utm_term=.8bc16ed7d0dc

25 See generally, David C. Mowery et al. (2004). Ivory Tower and Industrial Innovation: University-Industry Technology Transfer Before and After the Bayh-Dole Act. Stanford University Press.

26 ARPA-E's current policy indicates that the agency issues licenses for one-time payments. We suggest a running royalty fee for licenses that would generate continuous revenue for commercialized products. ARPA-E Website, "Licensing 101" https://arpa-e.energy.gov/sites/default/files/documents/files/Edmonds%20Licensing%20Presentation%20-%20April%202013.pdf

27 Stephen Overly (2017). Washington Post. https://www.washingtonpost.com/news/innovations/wp/2017/03/16/this-government-loan-program-helped-tesla-at-a-critical-time-trump-wants-to-cut-it/?utm_term=.54bb92ea56c2

28 Scott Wooley, (2013) "Tesla is Worse than Solyndra" Slate. https://slate.com/business/2013/05/tesla-is-worse-than-solyndra-how-the-u-s-government-bungled-its-investment-in-the-car-company-and-cost-taxpayers-at-least-1-billion.html

DESIGN

Jon White

JONWHITESTUDIO.COM

PUBLISHER

People's Policy Project is a think tank founded in 2017. The primary mission of 3P is to publish ideas and analysis that assist in the development of an economic system that serves the many, not the few.

PEOPLESPOLICYPROJECT.ORG