

ADVANCED INDUSTRIES SERIES

# Going Local: Connecting the National Labs to their Regions for Innovation and Growth

By Scott Andes, Mark Muro, and Matthew Stepp

## Summary

Since their inception in the 1940s, the Department of Energy (DOE) national laboratories have been in the vanguard of America's global research and development leadership. However, the national innovation system has changed in the past 70 years. Today, much technology development and application occurs in the context of synergistic regional clusters of firms, trade associations, educational institutions, private labs, and regional economic development organizations. Unfortunately, legacy operating procedures limit the DOE labs' ability to engage fully with the regional economies in which they are located. This lack of consistent engagement with regional technology clusters has likely limited the labs' overall contributions to U.S. economic growth.

This brief argues that, in order to improve the impact of the national labs, DOE, states, and Congress should:

- Improve the labs as an economic asset
- Open labs to small- and medium-sized businesses
- Increase labs' relevance to regional and metropolitan clusters
- Provide greater flexibility in oversight and funding

## I. Introduction

U.S. economic prosperity revolves around the competitiveness of the nation's advanced industry sector: innovation- and science-technology-engineering-mathematics (STEM) worker-intensive industries focused on advanced production and services.<sup>1</sup> Central to the competitiveness of these critical industries is the U.S. innovation ecosystem, which functions most dynamically in U.S. metropolitan regions. Cities and their surrounding metro areas support innovation through concentrated knowledge flows, specialized workers, and dense supply chains that improve firm productivity through highly adaptive and specialized technology clusters.<sup>2</sup> As such, the nation's regional clusters are important sources of national problem-solving, innovation, and prosperity.

Located throughout the country, the Department of Energy's (DOE) 17 national labs (labs) stand as potentially pivotal institutions in many metropolitan economies and for overall national innovation, growth, and competitiveness. As centers of basic and applied technology research and development (R&D), the labs are well-positioned to serve as unique focal points for technology exchange among regional firms, universities, and economic development intermediaries. However, to date, the labs have made neither technology commercialization nor regional cluster participation a top priority.<sup>3</sup> As a result, they have been unable to optimally connect to the broader U.S. innovation ecosystem and deliver on their responsibility to contribute to national economic growth.

“Greater engagement with local industry clusters would benefit regional economies but also advance the labs’ national mission.”

Recently, though, a number of lab system leaders—as well as policymakers—have become increasingly interested in optimizing the role of the labs as engines of national and regional growth. Congress has taken up bipartisan legislation to enhance lab flexibility when engaging with the private sector.<sup>4</sup> Secretary of Energy Ernest Moniz has made lab reform a priority.<sup>5</sup> And a congressionally-mandated commission is assessing potential areas of reform, including technology transfer, lab management, private sector engagement, and budget consolidation.<sup>6</sup> What these developments have in common is a new recognition that regional economic development can (and ought to) be an important adjunct to—and expression of—the lab system’s larger national mission.

In keeping with these discussions, this report describes several barriers to—and opportunities for—DOE lab engagement within regions and suggests a number of possible policy responses to improve the labs’ connections to metropolitan economies. To be sure, the current level of regional engagement varies from one lab to the next, particularly given their diverse research missions; as such, not all critiques outlined here apply universally. Nevertheless, it would be generally beneficial overall for DOE, Congress, and state governments to take steps to ensure that the entire system becomes more attentive to those economic regions where the labs are located. As they did in the years following World War II, the labs must pivot once more to embrace a new mission that includes more active engagement with regional innovation systems within which they are located. Such engagement will not substitute for the labs’ critical national mission, but will instead complement and advance it.

## II. Defining the Lab System

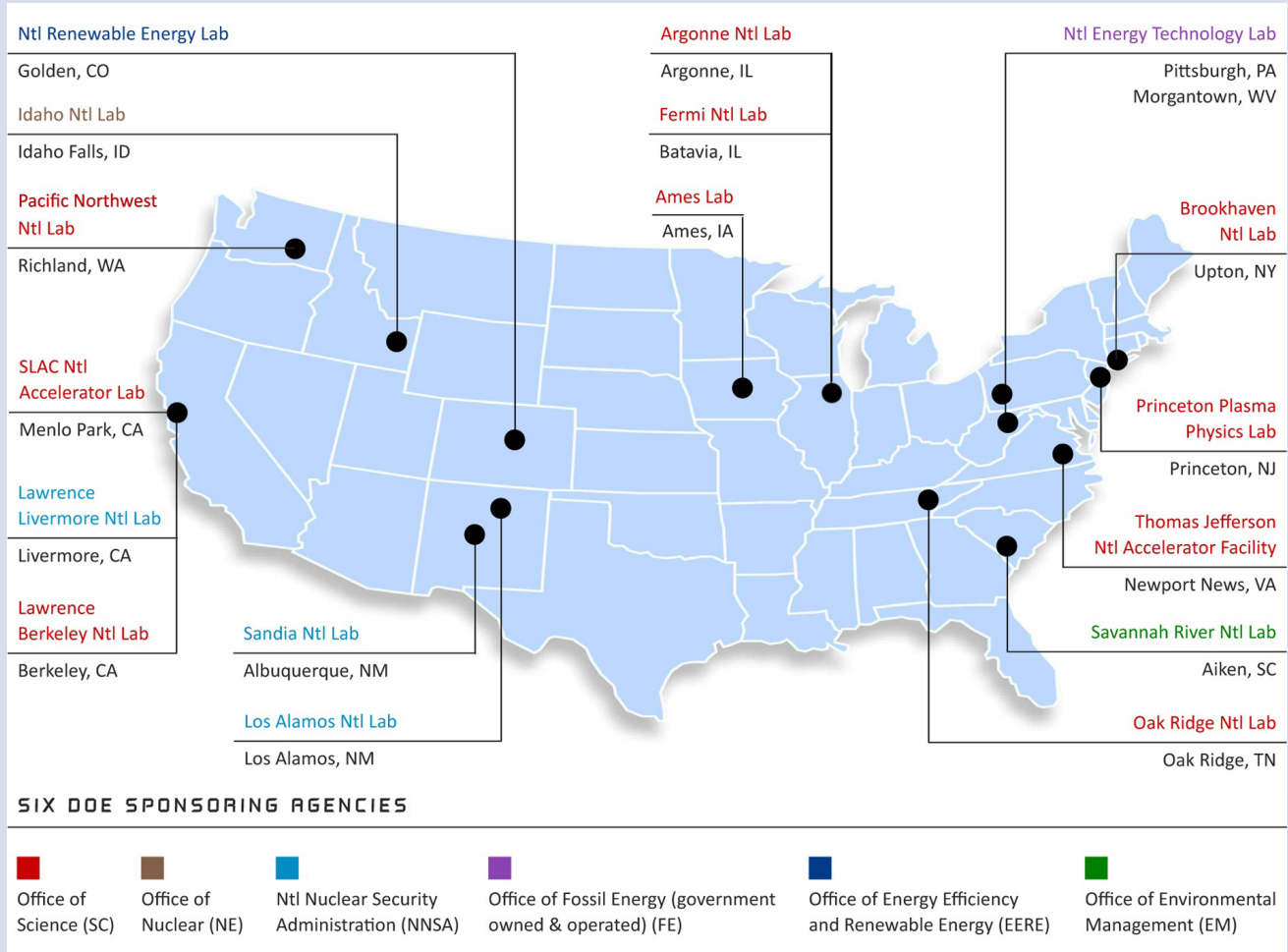
DOE’s national laboratories conduct multidisciplinary research in areas that are not currently commercially viable for the private sector and that exceed the capabilities of the country’s universities and private research facilities. The first labs were created in the 1940s, as part of the United States Atomic Energy Commission (AEC), to manage atomic weapons research and development. Upon successfully building the world’s first atomic bomb and hastening the conclusion of World War II, the lab system took on new missions focused on national security, advanced nuclear energy research, electric power development, novel materials, and computing.

Today, the 17 labs conduct more than \$12.5 billion in publically funded research and work on a wide range of national issues, including clean energy, physics, and advanced materials. Secretary of Energy Ernest Moniz has stated unequivocally: “The Energy Department’s national laboratories are a leading force in driving U.S. scientific and technological innovation and advancing the Department’s science, energy, environmental, and national security missions.”<sup>7</sup>

Sixteen of the 17 labs operate as government-owned, contractor-operated (GOCO) federally funded research and development centers (FFRDC). In other words, the labs are owned—or “stewarded”—by the federal government, which contracts their individual management to third parties for a modest fee. The so-called GOCO model was created to allow the labs to address their national research priorities while being managed flexibly and competitively by nongovernmental contractors. The government sets research priorities and invests in a significant portion of lab projects through congressional appropriations. DOE site offices are located at or near the labs, providing on-the-ground agency oversight of lab research.

The distinctive approach of the lab system is implemented through each lab’s unique scientific and technological expertise. At the highest level, each facility focuses on science, energy, or weapons research. The science labs were created to work primarily on big-picture science problems requiring large facilities, and include the Advanced Photon Source at Argonne National Laboratory in Illinois. The energy labs, including the National Renewable Energy Lab in Golden, Colorado, work on applied technology problems related to nuclear fission, fossil fuel, and renewable energy development. Weapons labs, such as New Mexico’s Sandia and Los Alamos National Laboratories, develop and maintain the technical systems and components that comprise the U.S. nuclear arsenal; these labs also conduct other defense-related work. Only rarely have individual labs’ nationally determined research agendas tended to dovetail with the evolution of local technology clusters. Instead, they may be better understood primarily as a national system with national (even global) impact.

**Figure 1. Location and Stewarding Agencies of the 17 DOE labs**



Source: The Information Technology and Innovation Foundation; Center for American Progress; and Heritage Foundation; "Turning the Page"

However, as science and technology have evolved in the 21st century, the labs have pursued more crosscutting, integrated research that simultaneously reflects each lab's evolving technical expertise and blurs the lines between their traditional boundaries. Energy labs conduct basic science as it pertains to spurring breakthroughs in energy technologies, while weapons labs often apply their unique expertise in materials and other technologies to conduct non-defense work in energy and science. Today, rather than operating as single-focus research facilities, the labs respond to the needs of modern scientific progress by serving as platforms for large-scale multidisciplinary work. As the labs' research portfolios have grown more inclusive to reflect the demands of modern science, they are increasingly well positioned to respond to the near- and middle-term technology needs of the firms and industries in their home regions.

And yet, only recently has technology transfer become a priority for the lab system. Prior to 1980 and the passage of the Stevenson-Wydler Technology Innovation Act commercialization of lab research was a secondary mission.

### Laboratory in Focus: The National Renewable Energy Laboratory

The National Renewable Energy Laboratory (NREL) is located in Golden, Colorado, and is the United States' premier site for research in next generation energy technology. With core competencies in solar, wind, transportation technologies, and economic modeling, NREL supports the U.S. energy sector by forecasting energy markets and developing technologies to meet demand. NREL is also one of the best labs at working with industry and features a much higher ratio of private sector contracts than DOE's lab system as a whole. However, as Denver has grown increasingly important for global renewable energy firms, NREL has needed to refocus its technology transfer efforts closer to home. One such successful effort is the Colorado Energy Research Collaboratory, a regional research consortium between NREL and three other Colorado research institutions that provides the region's energy industry a direct avenue to work with leading scientists and engineers. For example, the Center for Research and Education in Wind, one of the Collaboratory's four research centers, serves as a central location for regional wind energy firms to address near- and long-term technical issues ranging from turbine testing and certification to atmospheric modeling.

*Source: "Innovation Impact," National Renewable Energy Laboratory website, 2014.*

Today, two principal methods exist by which the DOE labs engage with industry to commercialize research: intellectual property (IP) licensing and lab-industry research collaborations. The labs license federally-funded IP to industry through their technology transfer offices. In 2011, the labs earned nearly \$45 million in licensing revenue from roughly 5,300 active technology licenses. More importantly, the labs also formally collaborate with firms and universities on research projects, particularly when unique lab infrastructure and user facilities are needed to address private sector problems. For instance, in 2011, the labs participated in over 700 cooperative research and development agreements, or CRADAs, with industry and universities.<sup>8</sup> In addition, the labs subcontracted \$500 million in research to universities to conduct joint projects.

These commercialization efforts have propelled U.S. competitiveness by contributing to innovations such as GPS, advanced automobile batteries, and revolutionary cancer treatments, to name a few.<sup>9</sup> In this regard, the labs have made significant contributions to human knowledge, met important mission needs, and undertaken high-risk research of long-term importance to the U.S. economy that has been beyond the reach of the private sector.

Over time, the labs have also made strides to more aggressively commercialize homegrown research into the private sector. For example, the labs and DOE have piloted the Agreement for Commercializing Technology (ACT), which accelerates the research collaboration process between the labs and select industry partners by reducing DOE involvement in formalizing agreements.<sup>10</sup> Additionally, DOE launched the America's Next Top Energy Innovator Challenge, which reduced the cost of licensing lab-held patents so that startups could quickly use the technologies to support business creation. However, the fact remains that these aggregate technology and tech-transfer impacts—while welcome first steps—fail to aggressively and fully seize the opportunity to turn federally funded research into new products and services, particularly at the state and regional level.

National competitiveness depends on metropolitan vitality, which is contingent on vibrant regional technology exchanges, especially among younger small- and mid-sized enterprises (SMEs). Such dynamic regional exchanges frequently require not only clusters of advanced industries firms but also the presence of sizable focal points—like the national labs—to further innovation exchange and technology adoptions. However, despite their undeniable potential, most national labs appear to contribute only marginally to the build-out and dynamism of their regions' local innovation clusters.

### Laboratory in Focus: Oak Ridge National Laboratory

Oak Ridge National Laboratory (ORNL) in Knoxville, Tennessee is DOE's largest science and energy lab, with a \$1.6 billion annual research budget and scientific capabilities in technologies such as computing, batteries, and advanced materials. Thanks to assets that range from Titan (one of the world's most powerful super computers) to unmatched research in material science, ORNL stands out as a linchpin for U.S. innovation in both basic and applied R&D. Traditionally, despite its global leadership in R&D, the lab has struggled to match its scientific expertise with the needs of key industries in East Tennessee. Recently, however, ORNL has taken steps to better align with the regional economy. Most notably, the lab's Carbon Fiber Consortium has worked to include Tennessee companies in a partnership of larger international and domestic firms organized around ORNL's extensive focus on carbon fiber as a cost-effective, lighter alternative to steel. Similarly, the Manufacturing Development Facility supports regional manufacturing companies through a variety of activities, including work to perfect advanced additive manufacturing techniques that allow for faster product prototyping.

Source: "A unique resource," Oak Ridge National Lab website, 2013.

## III. Challenges in Connecting the Labs to their Regions and States

For all of the promise embodied by the lab system, a number of significant administrative, policy, and cultural factors impede the labs' deeper enlistment in regional economic development as an important complement to their national missions.

DOE's labs, while invaluable national resources, remain at present too mission-focused and too little incentivized to plunge deeply into their respective regional economies.<sup>12</sup> A recent inspector general report on DOE's technology transfer capabilities stressed this perspective.<sup>13</sup> This is not to say that no regional engagements occur: Positive examples include ORNL's Carbon Fiber Consortium and NREL's participation in the Colorado Energy Research Collaboratory. (See "Laboratory in Focus" boxes).<sup>14</sup> However, while most labs provide technical assistance or analytic work to support regional economic development initiatives, the majority of lab activities remain "behind the fence." Meanwhile, when private-sector collaboration does occur it tends to be oriented towards large, remote firms with the financial capability to pay the costs of collaborating with the labs.

Furthermore, the challenge the labs face is not just structural and programmatic, but also cultural. Historically, DOE leadership has simply not taken lab commercialization and regional technology cluster dynamics seriously enough, nor has it fully appreciated that the labs can maximize their impact on the national economy by maximizing their local economic impact.

At least four problems limit the impact of DOE labs on their surrounding regional economies:

**DOE's economic strategy remains inconsistent.** The national labs have only recently begun to focus seriously on economic development, whether regional or national. In fact, for much of their history, the labs' main mission was to develop defense technology—and clean up after its testing.<sup>15</sup> Even today, DOE's defense and nuclear cleanup efforts comprise over one-third of the agency's R&D expenditures.<sup>16</sup> This deep heritage of defense activity has created a culture within the labs that is occasionally still resistant to collaboration outside of the federal government and prone to programmatic stovepipes.<sup>17</sup> Although the focus of research has shifted in the postwar decades, even today the legacy of military history ensures that the basic science and defense labs often still operate as if commercial applications and private-sector partnerships were inconsistent with their scientific missions.

A case in point is DOE's Commercialization Fund, called for in the Energy Policy Act of 2005 to support technology transfer. Instead of creating a strategy for commercialization funding, DOE retroactively applied the matching funds individual labs offered to firms through CRADAs toward the minimum funding requirement. According to a recent DOE audit, the Office of Inspector General concluded DOE's retroactive approach "did not demonstrate any planning or foresight...and did not sufficiently implement the Congressional intent."<sup>18</sup>

A second issue is that the lab research process does not easily lend itself to market demands. Frequently, commercialization becomes a priority only late in the process. The labs produce research sequentially, with lab scientists and other personnel applying for federal Funding Opportunity Announcements (FOAs), pursuing research, and seeking market opportunities only after the research is deemed complete. Ideally, researchers and technology transfer officers would engage frequently over the course of a given research project to ensure that the end result meets *both* the needs of the federal funding agency and the market. However, because few federal FOAs require economic partnerships or outcomes, there is little incentive for lab scientists to engage with technology transfer officers during the research. Even in mission-driven basic science research, where economic outcomes may not be the primary goal, the lack of a more iterative process between funding, research, and tech transfer creates a barrier between lab research and its potential economic impact.

Finally, while individual labs have strong interdisciplinary capabilities, the system's overall organizational structure remains excessively segmented into research and mission areas that make it difficult to consistently align with industry needs.<sup>19</sup> Depending on mission legacy, each lab approaches technology transfer and commercialization differently. For example, "basic science" labs—mostly under the Office of Science—and those labs that serve as stewards to the nuclear stockpile have very different relationships with the private sector than the energy laboratories, which are often more open to industry collaboration. However, although the diversity of the labs' missions need not preclude the sharing of best practices or common standards for technology transfer and commercialization, DOE lacks centralized economic priorities that are shared across the lab system. Secretary Moniz's efforts to merge a number of energy and science offices into one under secretary for science and energy that would oversee most of the department's non-weapons-related national labs may indicate that DOE is moving to improve the system's integration activities to allow it to better meet industry's needs for cross-cutting solutions.<sup>20</sup> However, until Secretary Moniz's appointment for under secretary is confirmed by Congress and he makes clear that the Office of Science and Energy has been tasked with helping labs become more agile in their respective regions, the ability of the labs to spur regional and national economic growth will remain suboptimal.

**Smaller firms find it difficult to work with the lab system.** A second problem that depresses the labs' contributions to regional economic development is their heavy orientation toward large firms.<sup>21</sup> SMEs matter inordinately in regional development. While large firms are extremely important to the national innovation ecosystem, not all of DOE's 17 labs reside near a Boeing or Microsoft lead design facility. Meanwhile, innovative SMEs play a huge role in the U.S. advanced economy—and are found in numbers within the advanced industry clusters adjacent to many DOE labs. This proximity holds solid potential for technology-based economic development, especially in circumstances where the lab's scientific activities relate to local industry needs. Unfortunately, however, the labs' heavily bureaucratic and complex contracting rules and long contracting timelines align poorly with the needs of smaller firms.<sup>22</sup> As a result, the lab system's ability to act as a synergistic participant in local technology clusters is compromised.

There are a number of reasons why small firms have a difficult time working with the labs. First, the labs' partnership system revolves around contracts through which firms essentially pay for services or the use of lab facilities. SMEs rarely possess adequate financial resources to engage with the labs, nor do they usually possess the requisite in-house scientific knowledge to collaborate with lab facilities.

Second, the time from submission to approval for the average CRADA or non-federal work for other agreement (NF-WFO) is out of step with the timelines of most SMEs. SMEs, particularly SME manufacturers, operate contract-to-contract and rely on near-term contractual requirements to cover business expenses. However, the average CRADA takes 110 days for the lab to process and an additional 12 days for each respective site office to review and approve.<sup>23</sup> NF-WFO agreements take 81 days on average, with an additional two weeks for DOE federal site office approval. SMEs simply cannot wait this long to address technological difficulties. Large companies, on the other hand, work on longer contract timelines and generally have sufficient liquidity to handle long contracting periods.

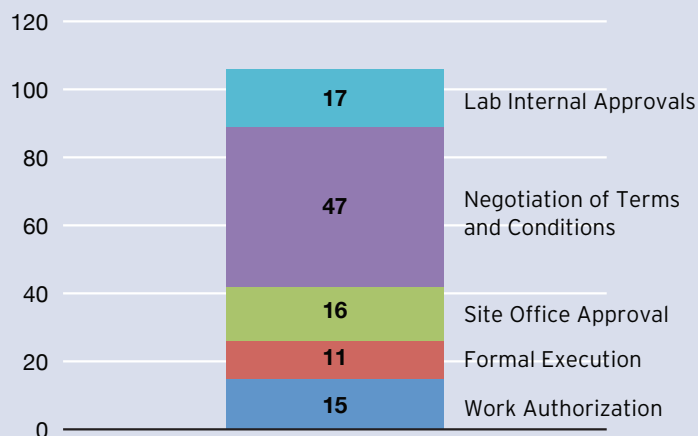


**Figure 2. Agreement Execution Cycle Time**

Type	Mean # of Days	Range
Laboratory CRADA	110	46 to 192 days
Laboratory NF-WFO	81	52 to 135 days
Federal Site Office CRADA	12	3 to 20 days
Federal Site Office NF-WFO	14	4 to 40 days

Source: U.S. Department of Energy, 2011.

Of even greater concern are the kinds of activities on which most of the approval time is expended: Over 44 percent of approval time is spent negotiating terms and conditions between the lab, the site office, and the firm—nearly triple the time spent on lab internal approvals, the second most time-consuming activity.<sup>24</sup> This is a problem because SMEs face well-documented hardships in covering consulting, legal, and administrative costs.<sup>25</sup> While fixed legal costs represent a small share of total production value for large firms, this is not the case for SMEs. As a result, the prospect of spending nearly 50 days in legal negotiations keep all but the most profitable SMEs from engaging with labs. While other contractual arrangements with the labs (such as WFOs and user agreements) are less legally demanding, all agreements that require contractual arrangements with DOE are generally recognized to be prohibitively expensive for most SMEs. If national labs are to leverage regional firms and technology clusters, partnering arrangements must better serve firms with shorter time horizons and few legal resources.

**Figure 3. Average Time to Process a CRADA, by Activity, in Days**

Source: U.S. Department of Energy, 2011.

**Labs are not incentivized to engage regional industry clusters.** Just as too few lab agreements are signed with SMEs, labs also maintain too few engagements with regional clusters in general.<sup>26</sup> Firms often lack regular forums or networks through which to interact with labs in their region. To be fair, most national labs do organize some regional engagements. However, these are often ad hoc one-offs and are not always well-attended by senior lab management.

To some extent, the problem is geographic. Given their frequently secure missions, few national laboratories are located directly within one of the nation's largest 100 metropolitan areas (although many labs are located close to one). Moreover, because the vast majority of lab activity transpires "behind

the fence” of the labs’ primary campuses, firms, universities, and other actors within the regional innovation system must go to the lab to interact with DOE resources.<sup>27</sup> However, this model stands in direct contrast to the practice of universities and private labs, which for decades have created satellite co-location spaces to support collaborative research. The problem is exacerbated by the fact that most labs are located outside of major metropolitan areas because of their legacy of nuclear weapons development. Without outpost offices near technology clusters—including universities, startup incubators and accelerators, other labs, and large firms—regional engagement across the lab system too often remains confined to disparate weekend conclaves in which the lab invites SMEs and university staff to showcase technologies. Establishing long-term partnerships, either with business clusters or external research labs, will require labs to be more engaged and substantive economic partners.

In addition to problems of location, benchmarking metrics—where they exist—fail to measure a lab’s involvement with regional clusters. For example, labs are annually evaluated under the Performance Evaluation and Measurement Plans (PEMPs), which include eight broad goals ranging from safety to management leadership. PEMP grades are meant to indicate lab management’s degree of professionalism and to grade lab success. Positive PEMP grades indicate that lab contractors receive full payment of their fee from DOE and are used, in part, to evaluate lab contract renewal. However, none of the eight PEMP goals remotely address regionalism, interaction with local industry, or technology transfer in general. If lab contractors aren’t graded for their technology transfer or regional prowess, there is simply no incentive for the labs to engage aggressively.

To be sure, the Energy Policy Act of 2005 mandated that DOE provide a comprehensive plan for the use of quantitative metrics to evaluate technology transfer by 2006. However, eight years later, DOE has still not submitted metrics for congressional review.<sup>28</sup>

The closest DOE comes to capturing regional engagement is by requiring labs to report some basic technology transfer metrics (which are also not currently part of PEMP).<sup>29</sup> However, technology transfer metrics (licensing agreements and revenue, user agreements, and patents) often do not actually relate to the valuable regional engagements that can exist through less formal partnerships and interactions. In fact, consistent, structured meetings between lab management and regional leaders are a precursor to formal technology transfer because these engagements enable labs to stay abreast of firms’ technology needs and help firms become aware of their regional lab’s research portfolio.

Finally, the lab system’s budget and fiscal timeframes and requirements are often at odds with the accelerating dynamics of technology-based economic development. DOE funding and FOAs, after all, come with rigidly defined timescales for research activity (usually based on fiscal year funding cycles), but opportunities for regional synergies emerge organically, often unexpectedly, and depend on a myriad of factors. Without the ability to shift or repurpose portions of preexisting funding, labs often miss out on regional research partnerships. For example, if the Colorado School of Mines (CSM) in Golden receives National Science Foundation (NSF) funding for next-generation solar photon conversion and NREL has preexisting funding from DOE’s Office of Energy Efficiency & Renewable Energy (EERE) in the same research area, NREL currently cannot redirect some portion of its federal funding to collaborate with CSM. The outcome: two world-class research institutions within five miles of each other doing similar but completely independent research. Unfortunately, this hypothetical is all too common.

Without greater efforts to co-locate near economic clusters, the introduction of clear incentives to engage with local firms, and the flexibility to align with regional research needs, DOE national labs will continue to underperform as agents of regional growth.

**DOE and congressional micromanagement restricts labs’ regional engagement.** A final area of concern revolves around the fact that even if lab managers were properly incentivized to engage intensively in regional economic development, they would be hobbled by DOE’s intrusive oversight. Congress originally defined the labs as government-owned, contractor-operated (GOCO), but in reality, DOE site offices at or near each lab are required to approve research agreements and contracts and make sure DOE standards are met—in effect placing DOE oversight staff at each lab. Restrictive oversight essentially forces lab managers to be rule followers instead of leaders responsible for overall lab outcomes.

In addition to direct DOE oversight, micromanagement of investment decisions by DOE and Congress makes it incredibly difficult for lab managers to regionalize their research and outreach efforts. First, congressional R&D appropriations remain highly stove-piped. Congress maintains 51



distinct appropriations and 111 separate funds or line items for major labs' projects and activities. The labs are also funded through an additional six programs, run by DOE assistant secretaries and directors, that are largely defined by historical missions (e.g., nuclear energy, fossil energy, renewable energy) and do not reflect the robust and multidisciplinary reality of lab research.

Given these strictures, lab managers cannot shift resources to meet changing demands, and are therefore often ill-prepared for changes in their region's economic or technology investment climate. For example, if aluminium prices increased and ORNL wanted to pursue cheaper composites alternatives in collaboration with East Tennessee auto suppliers, funding would likely come from one of 10 distinct technology funds with limited ability to cross-purpose budgetary resources. Along similar lines, lab overhead expenses (non-project-based costs) come with extremely tight restrictions. Most notably, Congress requires lab managers to navigate 26 unique categories with little to no room to maneuver.<sup>30</sup> With oversight costs so tightly controlled by DOE and Congress, lab managers have little opportunity to explore regional innovation opportunities with the funding at their disposal. This is particularly worrisome given that virtually all of the labs' technology transfer resources come from overhead funds.

While congressional action would be required to address much of the lab system's financial stove-piping—including adjustment of congressionally approved line items—several improvements could be made without engaging Congress. Because funding through the six assistant secretaries and directors flows solely at the discretion of DOE leadership, these funds could be reorganized through administrative changes.

#### IV. Toward More Regionally Connected National Labs

The implication of these problems is clear: Absent action to address their shortcomings as regional actors—including their weak economic mission, hurdles to small-firm partnerships, a lack of regional engagement, and restrictive DOE oversight and funding—the national labs will remain marginal participants in local technology clusters. An opportunity will have been lost.

To ensure, then, that the national laboratories leverage their potential to advance U.S. competitiveness by engaging more with their local economies, significant operational changes are necessary. Some of these changes require institutional reforms through DOE. Some will require legislation. Meanwhile, states and localities could be helpful in forging improved connections. Four major strategies would help:

**Improve the labs as economic assets.** To begin with, a stronger, regionally flavored economic development mission should be promoted. After all, 60 years have passed since the labs moved beyond their solely military objective. Consequently, the time has come to reorient national laboratory efforts more fully toward economic development and global competitiveness. DOE leaders can help the labs make that pivot right away. To start with, the DOE should:

- **Task the labs with a regional economic development mission:** The secretary of energy should use his “bully pulpit” to explicitly position the labs as economic institutions tasked with supporting regional technology clusters. While weapons-related labs have a unique national security mission, most DOE labs work in areas where regional economic support would not constitute mission creep. In particular, the secretary should clearly outline the collaborative, engaged role that national labs should have in regional economic development
- **Create a tangible, fully-funded Commercialization Fund:** As suggested by the inspector general's DOE audit, rather than retrospectively using CRADAs to meet Congress's minimum requirements for the Commercialization Fund, DOE should create a tangible, fully-funded Commercialization Fund to support expanded technology transfer programs within DOE
- **Task management of the Commercialization Fund to the technology transfer coordinator:** Upon creating the Commercialization Fund, the DOE should task management of the fund to the technology transfer coordinator (when he or she is appointed). This individual should create a comprehensive annual strategy to use the Commercialization Fund to support new technology transfer efforts and programs and build out the Office of the Technology Transfer Coordinator<sup>31</sup>
- **Scale best practices that currently exist within individual labs:** Each lab currently pursues technology transfer and commercialization differently, with some labs achieving more success

than others. DOE should catalog individual lab efforts and scale best practices across the lab system through the Office of the Technology Transfer Coordinator. For too long, distinct missions have impeded cross-pollination of best practices. While each lab may have a unique mission, they should all prioritize regional economic development

- **Create regional partnership and economic impact criteria in DOE FOAs:** Lab researchers play a significant role in seeking research funding through FOAs. In order to bring regional economic development officers into contact with research teams earlier in the process, DOE should include technology transfer outcomes in the FOA requirements and success metrics

**Open labs to SMEs.** Progress in this direction can also be made administratively. Most advanced industries—including automotive, aerospace, IT design, and biotechnology—are endowed with long supply chains that contain a variety of firm sizes. For that reason, labs cannot be active players in their regions' technology clusters without engaging with all types of relevant firms, including smaller local ones. Accordingly, in order to make lab contracts more accessible for SMEs, DOE should:

- **Create a simple, expedited lab agreement, particularly for regional firms:** Labs need a consistent contract option to support SMEs and other firms for whom existing models are not working. In 2012, DOE began piloting a new user agreement called the Agreement for Commercializing Technology (ACT), which allows contractors greater flexibility in negotiating terms. Because lab managers, not DOE, take on the risk of ACT agreements, DOE preapproval can take just 10 days. ACT may not be the most appropriate model for all labs, but it represents a simple, timely alternative to CRADAs and non-federal WFO agreements. DOE should fully implement a contracting model—ACT or an alternative—that substantially reduces the cost and time requirements of traditional agreements. Currently, firms that receive federal funding are excluded from ACT; whatever contract model DOE adopts, no firm should be excluded regardless of other federal funding that the firm may receive<sup>32</sup>

- **Extend the same user support resources to DOE applied technology offices that exist within national user facilities:** The Office of Science operates 32 national “user facilities”—federally sponsored research facilities available for external use.<sup>33</sup> User facilities have a number of resources that make user agreements low-cost and accessible to regional firms. For example, in many instances, nongovernmental users can obtain access to user facilities at no cost based on peer-reviewed proposals. Similar support and access policies should be extended to all national lab programs and centers

- **Create a National Laboratories Innovation Voucher Program:** DOE should encourage labs to establish a low-dollar research voucher that would allow SMEs to purchase “research hours” from labs for consulting services. Because no financial exchange would occur in such a program, the time spent on terms and contracts would be far less than for traditional user agreements. An ideal voucher would be DOE-funded and could be used at any DOE laboratory. However, if DOE does not create its own voucher program, state governments should consider working with national labs within their borders to fund the program<sup>34</sup>

**Increase labs' relevance to regional and metropolitan clusters.** The goal of a reoriented lab system, meanwhile, is not to turn the labs into local development agencies but rather to get them involved in the regional and metropolitan technology clusters that drive economic prosperity. To better engage with technology clusters, therefore, DOE, Congress, and lab managers should:

- **Create off-campus “microlabs” to provide a “front door” to the labs:** DOE, Congress, state governments, regional consortia, and other federal agencies that utilize the lab system should work together to create and co-fund a number of off-campus, small-scale “microlabs”—co-located within or near universities or private-sector clusters—that would cultivate key strategic alliances with regional innovation clusters. Microlabs would help overcome both the problem that most labs are located outside of major metropolitan areas, and the fact that most lab research occurs “behind the fence” of main campuses. These microlabs could take the form of additional joint research institutes or new facilities that allow access to lab expertise for untapped regional economic clusters. Accessible, off-campus lab space would also help labs engage with SMEs. Congress should legislate the creation of microlabs and require state buy-in, or state governments or regional consortia could create voucher programs in concert with DOE and particular labs

- **Align success metrics and lab report cards to incentivize regional engagements:** DOE should complete and submit its plan for using metrics to evaluate technology transfer to Congress as stipulated in the 2005 Energy Policy Act. In conjunction with this DOE-wide strategy, lab stewards should create or elevate the technology transfer component of the PEMP's grade into the top mission goal category. Along with elevating the technology transfer component, DOE stewards should create a regional engagement target in PEMP's. For example, DOE could introduce a subsection into each technology transfer metric that highlights the percentage of licensing, revenue, user agreements, and partnerships occurring within the lab's economic region.<sup>35</sup> In addition, DOE should move beyond traditional technology transfer metrics and analyze and incentivize nontraditional technology engagements such as relevant partnerships and projects
- **Fully implement performance-based rather than rule-based management:** Labs need the freedom to conduct day-to-day decisionmaking without arduous oversight from Washington.<sup>36</sup> Currently, lab managers lack that discretion because DOE micromanages lab business from its site offices and Washington.<sup>37</sup> The current contractor assurance system should be broadened to a true performance-based system where lab managers are responsible for outcomes, rather than highly regimented processes. Lab managers should be held accountable for lab research outcomes and institutional management through the PEMP reporting process, which directly impacts lab contractor fees and prospects for contract renewal
- **Allow labs to repurpose a small portion of existing funds for timely regional collaboration:** Increasing collaboration with regional universities and private-sector partners requires greater flexibility in funding contracts. DOE should allow labs to set aside a small amount—perhaps 10-15 percent—of existing fiscal year funding for unexpected research partnerships that may emerge throughout the year and that clearly align with lab mission and research goals. Labs would not be required to reserve these funds, nor required to invest in regional partnerships. However, for those that seek flexibility for local engagement, a portion could be set aside for that purpose. Similar repurposing rules should be encouraged for all federal FOAs intended for national labs

**Provide greater flexibility in terms of DOE oversight and funding.** Finally, the lab systems' oversight needs to be updated. Prescriptive top-down oversight and funding were important when the energy labs were the nation's primary sites for weapons development. However, in a metropolitan economy, labs must have the freedom to develop programming that reflects the technological challenges and assets of their respective regions. In order to free up labs for regional work, DOE and Congress should:

- **Allow labs to engage in non-federal state and regional funding partnerships that do not require DOE approval:** Currently, DOE must approve all non-DOE lab funding; this model is out of date, given that external funding is not trivial. For example, ORNL and Pacific Northwest National Laboratory (PNNL) already receive 50 percent and 80 percent of their respective budgets from outside of their DOE offices (though the majority of funding still comes from the federal government).<sup>38</sup> DOE should acknowledge that today's multidisciplinary lab work requires varied funding sources. As labs increase their relevancy to regional technology clusters, DOE should allow non-federal funding partnerships at lab managers' discretion. Initially, DOE could dictate a minimum amount of regional funding to be drawn from non-federal sources without its approval, and then gradually expand the minimum
- **Reduce funding silos to support regional collaboration, similar to the National Network for Manufacturing Innovation (NNMI) or the energy hubs:** Stovepiped appropriations keep lab research projects unnecessarily compartmentalized and hinder lab managers in responding to regional demands. Instead, labs should be funded to encourage broad, flexible engagements with numerous public and private actors. To this end, DOE and Congress should consider reorganizing lab funding to mimic the financial design of the new NNMI institutes or that of DOE's energy hubs. These institutions are designed with large, unencumbered appropriations aimed at complex, multidisciplinary regional technology and economic issues. As similar institutions, national labs should be funded accordingly

## V. Moving Forward

**M**aking progress on this agenda will not be easy, but it should be possible if all relevant actors are enlisted. To that end, DOE leadership, lab managers, Congress, and state and regional governments should all rethink their approach to the lab system in order to facilitate better engagement with the nation's regional clusters.

Many of this paper's administrative recommendations can be addressed by DOE. In particular, DOE should clearly prioritize the economic development mission of the labs and consider system-wide incentive structures for regional engagement. DOE management is also well positioned to scale technology transfer best practices amongst labs and streamline contracting procedures to better align with the economics of small firms.

At the same time, Congress is ultimately responsible for the funding silos that remain a binding constraint on the lab system, and will need to address them accordingly. Without better funding mechanisms that free lab managers to coordinate research efforts with regional technology clusters and work with SMEs and regional firms, the labs will likely remain inflexible and largely disconnected from their regional economies.

For their own part, lab managers do retain significant discretion in the overall direction of lab research. Some lab operators have prioritized regional engagements and actively worked with state and regional governments to create opportunities for researchers to support local businesses. Others, by contrast, have tended to discount calls for regional collaboration, claiming each lab is too distinct to learn from system-wide best practices. Given that, progressive managers should continue to develop new ways to situate lab research within a regional economic context (and seek greater discretion to do so), while other operators should take a new look at some of the emerging best practices.

Finally, state and local governments can do a lot to "pull" technologies out of the labs. By working with their labs to establish microlabs near local universities or business incubators, or by developing their own voucher programs, states can proactively partner with labs in their regions to amplify the exposure of lab research to the private sector.

## VI. Conclusion

**D**OE and the national labs have a history of excellence in meeting national missions, making revolutionary scientific discoveries, and developing breakthrough technologies. However, the structures, incentives, and cultural norms that define the nation's lab system must be updated to meet the new realities of the 21st-century innovation economy. In the years following World War II, the national labs were considered to have met their objective by producing technologically superior weapons for the United States and its allies. Yet, instead of closing their doors as war-time relics, the United States doubled down on the labs as national assets of innovation and economic advantage. Today, the labs must pivot once more to embrace the new economics of geography and engage more in the innovation systems within their home regions.

## Appendix A. Summary of Policy Reforms

This report proposes a series of administrative and policy reforms that would, if enacted, provide fundamental tools, strategies, and incentives for national labs to engage with nearby industry clusters. This appendix assigns proposed actions to the actor(s) that should take the lead on their implementation.

### Reforms Requiring DOE or Administration Action

The following reforms can be implemented directly by the DOE and/or the administration, but can also be legislated by Congress as necessary:

- **Task the labs with a regional economic development mission:** The secretary of energy should use his “bully pulpit” to explicitly position the labs as economic institutions tasked with supporting regional technology clusters
- **Create a tangible, fully-funded Commercialization Fund managed by the technology transfer coordinator:** Rather than retrospectively using CRADAs to meet Congress’s minimum requirements for the Commercialization Fund, DOE should create a true, self-standing fund. DOE should task the technology transfer coordinator with managing the fund, as well as developing a comprehensive annual strategy to support new technology transfer efforts and programs
- **Scale best practices that currently exist within individual labs:** The DOE technology transfer coordinator should catalogue individual lab efforts to promote and incentivize technology transfer and/or regional collaboration and scale best practices across the lab system
- **Create regional partnership and economic impact criteria in DOE FOAs:** To bring regional economic development officers into contact with research teams earlier in the process, DOE should make technology transfer outcomes part of the FOA requirements and success metrics
- **Align success metrics and lab report cards to incentivize regional engagements:** DOE should complete and submit its plan for using metrics to evaluate technology transfer to Congress, as stipulated in the 2005 Energy Policy Act. In conjunction with this strategy, DOE should create or elevate the technology transfer component of the PEMP’s grade into the top mission goal category, which should include metrics for regional/state engagement
- **Fully implement performance-based, not rule-based, management:** DOE should broaden the current contractor assurance system into a true performance-based system wherein lab managers are responsible for research outcomes, rather than tightly micromanaged by the DOE. Lab managers should be held accountable for their performance through the PEMP reporting process, which directly impacts lab contractor fees and prospects for contract renewal

### Reforms Requiring Congressional Action

The following reforms should be implemented directly by Congress or legislated in the absence of DOE or White House action:

- **Make the DOE applied R&D labs “User Facilities:”** All labs and lab centers should be extended the same flexibility, user interface, and resources as Office of Science User Facilities to facilitate third-party engagement with lab facilities and staff
- **Create off-campus “microlabs” to provide a “front door” to the labs:** Congress should give DOE the authority to create off-campus “microlabs” at or near lab sites. Ideally, the program would be co-funded by DOE and state or regional consortia, with microlabs located within or near universities or private sector clusters that fit the strategic missions of the labs
- **Allow labs to engage in non-federal state and regional funding partnerships without strict DOE oversight:** Congress should allow lab managers to collaborate with non-federal state and regional entities on R&D projects without strict DOE oversight and approvals. Initially, DOE could dictate a minimum amount of regional funding to be drawn from non-federal sources without DOE approval, while expanding the minimum over time
- **Avoid funding lab projects in small, micromanaged appropriations:** Congress should transition away from appropriating lab funding along very small, discrete, and micromanaged projects and move toward broader, mission-driven appropriations that labs can use to build strategies

For instance, Congress could utilize best practices from funding strategies for the DOE Energy Innovation Hubs or the National Network of Manufacturing Innovation (NNMI)

- **Allow labs to repurpose a small portion of existing funds for timely regional collaboration:** Congress should allow the labs to use a portion of their overhead funds (or a small portion of lab R&D appropriations) to fund timely state and regional collaborations that advance labs' missions and/or project goals
- **Create a National Laboratories Innovation Voucher Program:** Congress should allow DOE and the labs to establish a low-dollar research voucher to allow small and medium-sized enterprises (SMEs) to purchase "research hours" from labs for consulting services. An ideal voucher would be co-funded by DOE and state governments and could be used at any DOE lab

### Reforms Requiring State Government Action

The following reforms can be implemented by state governments in the absence of federal leadership:

- **Create off-campus "microlabs:"** State governments or regional consortiums could also take the lead in working collaboratively with particular national labs to create off-campus "microlabs" that provide a "front door" to lab resources, researchers, and programs. States could create the microlabs as an extension of regional economic development efforts in collaboration with universities and business groups
- **Create an innovation voucher program:** State governments should establish a low-dollar research voucher that would allow startup SMEs to purchase "research hours" from labs (as well as universities and other public research organizations) for consulting services
- **Include the labs as core stakeholders in state and regional economic development strategies:** National labs should be viewed as important components of state and regional growth strategies, in the same way that universities are often central to regional economic development. State and regional interest can act as a "demand pull" for DOE and lab engagement, particularly when partnered with state resource.

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32. Firms that receive federal funding are precluded from ACT. Prohibiting regional firms that receive other federal funds from participating in ACT reduces the incentive for collaboration among multiple federal programs.
33. A user facility is a federally sponsored research facility available for external use to advance scientific or technical knowledge under certain conditions. Note that many Office of Science user facilities are located at national labs. For a full list of user facilities, see “U.S. Department of Energy, Office of Science User Facilities, FY 2013,” available at [www.science.energy.gov/~media/\\_pdf/user-facilities/Office\\_of\\_Science\\_User\\_Facilities\\_FY\\_2013.pdf](http://www.science.energy.gov/~media/_pdf/user-facilities/Office_of_Science_User_Facilities_FY_2013.pdf) (November 2013).
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This paper is part of the Brookings Metropolitan Policy Program's Advanced Industries Series. Aimed at describing and advancing knowledge about U.S. advanced industries (characterized by R&D- and STEM-worker intensive industrial concerns), the series provides groundbreaking research and innovative strategy recommendations aimed at expanding the large role these industries play in delivering regional and national prosperity. Future work will map the metropolitan distribution of these industries and related innovation and workforce resources; catalogue best practices; and develop a federalist agenda for advancing the sector.

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## About the Authors

Scott Andes is a senior policy analyst at the Brookings Metropolitan Policy Program.

Mark Muro is a senior fellow at the program and its policy director.

Matt Stepp is the executive director of the Center for Clean Energy Innovation at the Information Technology and Innovation Foundation.

## For More Information

Scott Andes  
Senior Policy Analyst  
Metropolitan Policy Program at Brookings  
202.540.7725  
[sandes@brookings.edu](mailto:sandes@brookings.edu)

Mark Muro  
Senior Fellow and Policy Director  
Metropolitan Policy Program at Brookings  
[mmuro@brookings.edu](mailto:mmuro@brookings.edu)

Matthew Stepp  
Executive Director,  
Center for Clean Energy Innovation  
Senior Policy Analyst, Information Technology  
and Innovation Foundation  
202.626.5723  
[mstepp@itif.org](mailto:mstepp@itif.org)

## For General Information

Metropolitan Policy Program at Brookings  
202.797.6139  
[www.brookings.edu/metro](http://www.brookings.edu/metro)

1775 Massachusetts Avenue NW  
Washington D.C. 20036-2188  
telephone 202.797.6139  
fax 202.797.2965

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