



U.S. DEPARTMENT OF
ENERGY

Secretary of Energy Advisory Board

Recommendations on Laboratory Entrepreneurship Ecosystems

Presented to the Secretary of Energy on April 9, 2024



The following recommendations were approved by all members present at the April 9, 2024 public meeting with one recusal.

Executive Summary:

The Secretary of Energy Advisory Board (SEAB) examined the entrepreneurship ecosystems across the National Laboratory complex, including the Lab-Embedded Entrepreneurship Program (LEEP), as well as entrepreneurship efforts in the National Nuclear Security Administration (NNSA) Labs. The Lab Entrepreneurship Working Group members included Dr. Shirley Ann Jackson (Working Group Chair), Trenton Allen, Dr. John Dabiri, Philip Giudice, and Dr. Suzanne Singer. The Working Group also included two non-members of the SEAB: Tracy Mustin and Dr. Ravi Prasher. SEAB recommends the following across these programs:

1. **Organization and Communication:** DOE should collaborate with and coordinate between the Office of Science, the Office of Energy Efficiency and Renewable Energy (EERE) and NNSA Labs' entrepreneurship programs. DOE HQ should take on a direct role of encouraging cooperation across all labs to share best practices in their entrepreneurial partnering programs. DOE HQ should bolster efforts to involve both established and potential entrepreneurs, particularly from underserved and underrepresented communities.
2. **Funding and Funding Sources:** DOE should look at ways to increase funding support to entrepreneurship programs and to communicate its availability more effectively to interested candidates. Stable funding should be made available from DOE HQ to all DOE Labs with Lab Entrepreneurship programs, for the support of Fellows and basic programmatic elements.
3. **External Partnerships:** A focus on joint venture opportunities should be developed to provide Lab Entrepreneurship participants opportunities to have their technology inserted into larger supply chains as a method to scale and have impact.
4. **Metrics:** Metrics should be developed with milestones related to desired outcomes including bridge funding for scaling up to commercial viability, and the achievement of DOE clean energy goals.
5. **Recruitment and Mentoring:** A timely, consistent and structured approach to orientation and mentoring for all program participants should be mandatory. Broader outreach and participation of entrepreneurs from underserved populations should be structured into the Lab Entrepreneurship programs.
6. **Incentives for Lab Scientists:** DOE Headquarters leadership, NNSA, and Laboratory Directors must be aligned on and committed to entrepreneurship as critical to the overall DOE mission. Financial incentives and compensation structure for Lab scientists should reflect the importance of entrepreneurship and entrepreneurial thinking to DOE mission accomplishment. A venture fund or partnerships with existing funds, which have



patient capital, should be established to invest in commercializing technology derived from research at DOE Labs.

Context

It is well known that start-up companies are a key component of the U.S. innovation ecosystem and accelerate the deployment of technological advances into the commercial sector, while often outpacing larger enterprises in job creation. Given the significant infrastructure and scientific expertise at the DOE National Laboratories, it is important that these laboratories engage with technologically-based start-ups in substantive ways.

Historically, the National Labs have engaged with the private sector through Cooperative Research and Development Agreements (CRADAs). However, given their formality, intellectual property (IP) restrictions, and time to deploy, the CRADAs have tended to favor large enterprises. Many of them also have tended to have a more research orientation, as opposed to strong new technology deployment, even when research leads to technology breakthroughs by Laboratory scientists.

To bridge these gaps, and to address climate-driven energy challenges, the Lab-Embedded Entrepreneurship Program (LEEP) was created in 2015, by the DOE and DOE National Labs, to bring clean energy technological innovations to a level of maturity and deployment to simultaneously impact climate change, sustainability, and social justice. The program has been managed by the DOE Office of Energy Efficiency and Renewable Energy (EERE) and sponsored by its Advanced Manufacturing Office (AMO), and more recently primarily by the Advanced Materials and Manufacturing Technologies Office (AMMTO), as the LEEP Home Office.

To date, the program has been carried out at LEEP nodes at four of the seventeen DOE National Labs. They are Chain Reaction Innovations (CRI) at Argonne National Lab, Innovation Crossroads (IC) at Oak Ridge National Lab, Cyclotron Road (CR) at Lawrence Berkeley National Lab, and West Gate at the National Renewable Energy Lab (NREL).

LEEP's approach is to offer two-year fellowships to selected entrepreneurs, and to embed their early-stage start-up within a National Lab, in order to leverage the Lab facilities, with technical mentoring by Lab scientists. Through the node offices, the fellows receive business/entrepreneurship training, and are meant to be part of a local/regional/national support ecosystem.

The LEEP program has been successful in a number of ways, with 176 fellows supported, 154 new businesses started, 2244 new jobs created, and 97% of LEEP startups are still in operation today, after 10 years of LEEP's existence. Other metrics of success include the representation of LEEP start-ups in the American Made Challenges (AMC) competitions, and in Energy Earthshot



technology deployment. Moreover, the work of the Fellows and their start-ups covers a broad energy front – from clean-cooling, to renewable energy, to sustainable fuels, to energy storage, to carbon-free chemicals. The LEEP program expects to receive about \$12 million in funding in 2024.

Despite the successes, a number of challenges have surfaced in the past one to two years, identified by LEEP management and through observation by the SEAB Working Group. The challenges include variation in awareness of individual nodes inside and outside of DOE, and overall lack of awareness of LEEP generally; different operational modes and cost of Fellows across the nodes; lack of community across the nodes; difficulties with respect to the number of applicants and their diversity; and the burdensome nature of the CRADA process. There is work underway to address these issues and the Working Group recommendations are meant to support current improvement efforts already underway and to suggest additional avenues to support the program.

The entrepreneurship efforts in the NNSA Labs are more prescribed because of the very specific national security mission and requirements of those labs. It is important to note, for example, that three quarters of the work at Los Alamos National Laboratory is classified. Therefore, innovation with the private sector is more complicated. The funding model for their LEEP-type program is different than that of the DOE Office of Science Labs and NREL. The NNSA Labs do not have the overall infrastructure of the LEEP program, and their entrepreneurship activities have required much creativity on the part of the program leads - with respect to Lab-based funding for the entrepreneurs, and for connecting them to a larger entrepreneurial ecosystem.

Methodology

The SEAB Laboratory Entrepreneurship Ecosystems Working Group has examined different models of entrepreneurship ecosystems across the National Laboratory enterprise. The Working Group explored, as well, how to create and nurture an innovative and entrepreneurial mindset at the National Labs:

- Understanding and defining Entrepreneurship Ecosystems and comparisons to other models
- Metrics of success
- Consistency of approaches across LEEP nodes themselves, and with NNSA Labs
- Communications/Interactions within the LEEP programs, within the Labs, and outside (including partnerships)
- Funding and fiscal constraints
- Recruitment and mentoring
- Continuing interaction with, and support of, program participants.



The Working Group focused on six laboratories:

- NNSA/EM: Los Alamos National Lab, Savannah River National Lab
- Office of Science: Argonne National Lab, Lawrence Berkeley National Lab, Oak Ridge National Lab
- EERE: National Renewable Energy Lab

The Working Group interviewed program directors, program participants, Lab directors, and DOE HQ offices. The results of our review are captured in the Findings and Recommendations delineated in the following section.

Findings and Recommendations

Organization and Communication: Findings

There exist two main organizational elements for entrepreneurship programs for start-up companies:

- LEEP, managed by EERE, through the Advanced Materials and Manufacturing Technologies Office (AMMTO), with nodes at individual Office of Science or EERE Labs, each with a program director;
- NNSA Entrepreneurship programs, managed through individual program offices at the NNSA Labs, each with its own director, with no apparent central office for the NNSA Lab programs.

How the programs are organized and communicated throughout the Labs themselves, and throughout DOE is not structured or consistent, leading to a lack of awareness about the LEEP nodes and the NNSA entrepreneurship activities.

The program participants do not have a complete awareness or knowledge of the priorities of the individual program offices within DOE Headquarters, which could more usefully inform how they might access resources and internal partners.

The NNSA Labs have not reconciled how the Lab Entrepreneurship programs relate to their missions.

There is variability in the degree of true involvement of Lab scientists in the work of the start-ups, although technical support and Lab infrastructure are provided.

The CRADAs are designed more for larger entities, as opposed to start-ups because of their historical focus, IP requirements, and time to negotiate.

Organization and Communication: Recommendations



1. Office of Science, Applied Energy Offices, and NNSA Labs exist with a high degree of independence. While the missions of these organizations differ, while under the entrepreneurship umbrella, the collaboration and coordination should be more formalized and developed.
2. There should be an approach of continual and consistent communication, throughout DOE, of the existence, intent, and outcomes of the LEEP and NNSA Lab Entrepreneurship programs.
3. As part of the orientation for entrepreneurship fellows, a formal overview and introduction to the DOE program offices, their priorities, and funding opportunities should be included. In addition, an element of the fellowship program should be to ensure that fellows meet and share ideas among themselves in a given program, across nodes, and across Labs, to spur greater awareness, and opportunities for cross-fertilization and partnerships.
4. There should be reconciliation and/or coordination from the Office of the Secretary down through EERE, the Office of Science, and the NNSA with respect to the basic intent of the Lab Entrepreneurship programs across all offices, what is allowed or not allowed, how Lab scientists can be more involved in start-ups themselves (with enabling mechanisms beyond leaves of absence). For the NNSA Labs, in particular, there should be a clear articulation of how Lab Entrepreneurship programs help to support the missions of those Labs.
5. DOE should create a streamlined CRADA process, or a CRADA replacement tailored to Lab Entrepreneurship participants.

DOE HQ should take on a direct role in encouraging cooperation across all Labs to learn and share best practices in developing entrepreneurial partnerships. These would include reaching out to both established and potential entrepreneurs. There should be more explicit efforts to seek out underserved communities and others who have not typically been aware of National Lab entrepreneurship programs.

Funding and Funding Sources: Findings

LEEP nodes have program offices and funding to support Fellows for two years. The programs also specifically give Fellows access to Lab infrastructure, technical support, and Lab scientists (although the degree of their involvement with the Fellows varies across and within Labs).

For NNSA Lab entrepreneurship programs, funding for basic programmatic elements is pulled together by the person leading the program, in an entrepreneurial but ad hoc way, without central support.

Approaches to securing outside funding for the entrepreneurs' companies also varies significantly, sometimes from Small Business Innovation Research (SBIR) and/or Small Business Technology Transfer (STTR) programs, sometimes from state government programs – including



tax credits, sometimes from Federal government money sent to a state for economic development.

Across all programs, there is no real access to venture/bridge funding.

Funding and Funding Sources: Recommendations

1. DOE should look at ways to increase funding support to entrepreneurship programs and to communicate its availability more effectively to interested candidates. Stable funding should be made available from Headquarters to all DOE Labs, with Lab Entrepreneurship programs, for the support of Fellows and basic programmatic elements.
2. All participants in Lab Entrepreneurship programs should be made aware of and have the opportunity to seek financial support from all relevant DOE program offices.
3. All Lab Entrepreneurship nodes should develop knowledge of, and take a structured approach to identifying, various external funding opportunities for Lab Entrepreneurship start-ups, including state programs, local/regional economic development opportunities, and support from other Federal agencies.
4. A deliberate approach, beyond DOE funding, should be undertaken to support Lab Entrepreneurship start-ups in securing venture and bridge funding, in order for them to scale to commercial viability.

External Partnerships: Findings

There does not appear to be a consistent and systematic approach to partnership development, related to the technical focus of a given Lab Entrepreneurship start-up.

As such, not all program participants develop – through the Lab programs – an awareness of how to move their enterprises into a larger impact frame.

External Partnerships: Recommendations

1. Headquarters or program offices should provide support to program participants in applying for SBIR/STTR funding, as well as regional or state funding.
2. A focus on joint venture opportunities, including through larger CRADA participants, should be developed to provide Lab Entrepreneurship participants opportunities to have their technology inserted into larger supply chains as a method to scale and have impact.
3. Local, regional, and state businesses, through chambers of commerce, and universities, should be identified as potential partners for Lab Entrepreneurship graduates.
4. A systematic approach should be developed, through the nodes, to help entrepreneurs access venture and bridge funding. This could be done through linking program participants with local entrepreneurs who have been successful in getting more long duration funding.



Metrics: Findings

The following metrics are already used to measure Lab Entrepreneurship success: number of LEEP Fellows supported, number of businesses launched, follow-on funding, jobs created, participation in DOE competitions, longevity of businesses.

There are no real scaling metrics. It is not obvious how the companies created benefit the local and regional economies in a substantial way.

The impact on underserved communities is not really measured.

There are no metrics related to how the companies advance DOE clean energy goals nationally.

Metrics: Recommendations

1. Scaling metrics should be developed with milestones related to desired outcomes.
2. A metric should be considered based on bridge funding for scaling up to commercial viability.
3. Metrics should be developed related to achievement of DOE clean energy goals.
4. Insertion of start-up company technology into national supply chains should be monitored and measured to the extent possible.
5. The visibility of DOE-supported startups should be monitored and reported on.

Recruitment and Mentoring: Findings

A number of program participants expressed a desire to know more about the focus and priorities of DOE Headquarters program offices.

Some program participants have not received the programmatic mentoring they expected as Fellows.

Some program participants have experienced slowness in getting the technical infrastructural support expected.

There is variability of the degree of involvement by Lab scientists with Lab Entrepreneurship participants.

Broader outreach to underserved populations - urban and rural - needs strengthening.

Participation and enablement of immigrants in Lab Entrepreneurship programs is a concern among some program participants.

Recruitment and Mentoring: Recommendations



1. A timely, consistent and structured approach to orientation and mentoring for all program participants should be mandatory. This should include an overview of the DOE priorities, especially with respect to clean energy.
2. Each program participant should be assigned a mentor, and a scientific “buddy”.
3. There should be a defined timeline within which a program participant will be set up with technical support and infrastructure for their companies.
4. Beyond the LEEP program, Headquarters or program offices should emphasize and facilitate the relationship between the R&D at the labs and US-based commercialization/company development.
5. The expectation and/or requirement for a Lab scientist to be involved directly with the Lab Entrepreneurship program and its participants should be clarified with both Lab staff and program participants.
6. Broader outreach and participation of entrepreneurs from the aforementioned populations should be structured into the Lab Entrepreneurship programs.
7. How immigrant entrepreneurs can participate in Lab Entrepreneurship programs, and at which Labs, should be clarified. Enabling steps, including visa requirements should be included.

Incentives for Laboratory Scientists: Findings

Participation of Lab scientists in entrepreneurial start-ups is not high.

There are concerns with how entrepreneurship intersects (or not) with the national security mission of the NNSA labs.

Lab scientists are rewarded based on their scientific and technical expertise, not necessarily their entrepreneurial orientation.

Lab sabbaticals do exist for Lab scientists to go out and start a company and return, but other incentives are not obvious.

Incentives for Lab Scientists: Recommendations

1. DOE Headquarters leadership and Laboratory Directors must be aligned on and committed to entrepreneurship as critical to the overall DOE mission. This includes alignment between the Office of the Secretary and NNSA.
2. Discussions and clarification of how entrepreneurship relates to Lab missions are critical, throughout DOE, and the DOE Labs in particular.
3. Financial incentives and compensation structure for Lab scientists should reflect the importance of entrepreneurship and entrepreneurial thinking to DOE mission accomplishment.



4. Work should be undertaken, as appropriate and warranted, to garner Congressional support for Lab Entrepreneurship, and more comprehensive and centralized programmatic funding.
5. DOE should create a pathway to patient capital, through the creation of a venture fund, or partnerships with existing funds to commercialize technology derived from research at DOE Labs. Examples include, The Engine (MIT), Breakthrough Energy, and Prime Coalition. In addition, In-Q-Tel, set up by the Intelligence Community (IC), may provide a point of departure because it has helped to launch start-ups, based on IC-supported research.