Baseline and Process Evaluation of Small Business Vouchers Pilot

Final Report

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research into action inc

NMR Group, Inc.

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Acronyms and Abbreviations

ANL	Argonne National Laboratory
CAP	Central Application Platform
COI	Conflict of interest
CRADA	Cooperative Research and Development Agreement
DOE	U.S. Department of Energy
EERE	DOE Office of Energy Efficiency and Renewable Energy
FOA	Funding Opportunity Announcement
IP	Intellectual property
INL	Idaho National Laboratory
LANL	Los Alamos National Laboratory
LBNL	Lawrence Berkeley National Laboratory
MR Lab	Merit Review Lab
MTA	Material Transfer Agreement
NFS	Non-federal sponsors
NREL	National Renewable Energy Laboratory
ORNL	Oak Ridge National Laboratory
PI	Principal Investigator
PNNL	Pacific Northwest National Laboratory
POC	Point of Contact
RFA	Request for Assistance
TAPA	Technical Assistance Pilot Agreement
SBIR	Small Business Innovation Research program
SBV	Small Business Voucher pilot
SNL	Sandia National Laboratories
SOW	Statement of Work
SPP	Strategic Partnership Projects
STTR	Small Business Technology Transfer program
TTO	Technology Transfer Office
WFO	Work for Others Agreement

Glossary

This glossary defines terms whose usage may be specific to Small Business Vouchers Pilot. The glossary also serves as a primer on key Small Business Vouchers concepts and activities from inception through its second round of SBV requests for assistance. DOE continues to refine the pilot, and so details may change over time.

Central Application Platform (CAP)	Software to support a single web portal that small businesses use to request technical assistance from any participating national lab in any technology area providing SBV vouchers, and to support the storage, retrieval, eligibility screening, and merit review of the requests.
Conflict of interest (COI)	A personal, professional, organizational, or financial relationship or interest that unduly impacts the impartiality of a party. Conflicts of Interest can be actual (i.e., a relationship exists that affects a party's impartiality) or apparent (i.e., a relationship does not actually result in a conflict, but the nature of the relationship is such that a third party with an understanding of the facts would have cause to question the impartiality of a party to the relationship).
Cooperative Research and Development Agreement (CRADA)	A collaborative agreement that allows the Federal Government, through its labs, and non-federal partners to optimize their resources, share technical expertise in a protected environment, and access intellectual property emerging from the effort. CRADAs offer both parties the opportunity to leverage each other's resources when conducting mutually beneficial research and development (R&D).
Intellectual property (IP)	Intellectual property (IP) refers to creations of the mind, such as inventions, literary and artistic works, designs, and symbols, names, and images used in commerce. Lab IP that transfers to the commercial sector is commonly patented and licensed.
Lab	A DOE national laboratory.
Lab Call	*Small Business Vouchers Pilot Laboratory Call for Proposals,* March 23, 2015.
Lead lab	Labs selected by DOE in response to a Lab Call to implement the SBV pilot.

Material Transfer Agreement (MTA)	An MTA is a contract that governs the transfer of tangible research materials between two organizations, when the recipient intends to use it for his or her own research purposes. The MTA defines the rights of the provider and the recipient with respect to the materials and any derivatives.
Participating lab	Labs that are available to work with small businesses through the pilot.
Principal investigator (PI)	Serves as technology team's technical lead and overall project manager.
Point of contact (POC)	Lab pilot manager team staff assigned to answer questions about the pilot and technology areas overall, as well as lab technical staff assigned to answer lab-specific technology-specific pilot questions.
Requests for Assistance (RFA)	Small businesses apply for an SBV voucher by submitting a Request for Assistance describing, among other things, the technical problem for which they are seeking lab assistance.
SBIR	The Small Business Innovation Research Program (SBIR) is a highly competitive program that encourages domestic small businesses to engage in federal research and/or research and development (R/R&D) that has the potential for commercialization. (See STIR, below, and Appendix D.2.7.)
SBV	Small Business Voucher pilot provides U.S. small business with unparalleled access to the expertise and facilities of DOE's national labs by awarding to competitively selected small businesses vouchers valued between $50,000 and $300,000 to cover the cost of lab services.
SBV CRADA	A standard ten-page CRADA agreement developed by EERE for all SBV cooperative research and development agreements. To participate in the pilot, all parties (the labs, the small businesses, and DOE) must agree to use this contract for applicable research.
SBV TAPA	A standard three-page Technical Assistance Pilot Agreement developed by EERE for all SBV technical assistance agreements. To participate in the pilot, all parties (the labs, the small businesses, and DOE) must agree to use this contract for applicable research.

Site Office	Site Offices are organizations within the U.S. Department of Energy's Office of Science with responsibility to oversee and manage the Management and Operating (M&O) contractor for the national lab (*www.science.energy.gov/about/field-operations*). DOE's Office of Science oversees 10 labs; other DOE offices similarly manage M&O contractors for the labs under their purview. Contracts for all SBV voucher awards must be approved by the performing lab's Site Office.
Statement of Work (SOW)	Statement of Work (or SOW) is a formal document that defines the entire scope of the work involved and clarifies deliverables, costs, and timeline.
SPP	Strategic Partnership Projects (the successor to WFO; see below) is a policy to encourage and facilitate DOE and the national labs to pursue projects in partnership with other federal government agencies, state and local institutions, universities, private companies, and/or foreign entities.
STTR	Small Business Technology Transfer (STTR), like SBIR, expands funding opportunities in the federal innovation research and development (R&D) arena. Unlike SBIR, it requires small businesses to formally collaborate with a research institution. STTR's role is to bridge the gap between the performance of basic science and commercialization of resulting innovations. (See Appendix D.2.7.)
Technology Readiness Level	Technology Readiness Level, or "TRL" is a widely-used indicator of degree of development of a technology toward validation at commercial scale in the actual operating environment; degree of development is described on a scale of 1-9, with 9 being fully deployment ready.
Technology transfer	The process by which technology or knowledge developed in one place or for one purpose is applied and used in another place for the same or different purpose.

Technology Offices (also known as Program Offices)	EERE develops research agendas and directs and funds research through its Technology Offices: Advanced Manufacturing Office (AMO), Bioenergy Technologies Office (BETO), Building Technologies Office (BTO), Fuel Cells Technology Office (FCTO), Geothermal Technologies Office (GTO), Solar Energy Technology Office (SETO), Vehicle Technologies Office (VTO), Water Power Technologies Office (WPTO), and Wind Energy Technologies Office (WETO).
Technology Transfer Offices (TTO)	Offices in federal labs staffed with "highly competent technical managers" who are "full participants [along with the innovating scientist or engineer] in the technology transfer process." They are empowered to develop and promote the key partnerships necessary for technology transfer.
User facility agreement	Agreement enabling businesses or universities engaged in areas of commercial and basic science research to use facilities at all DOE national labs with approved designated user facilities.
Voucher performing lab	A lab that partners with a small business to perform the statement of work for which the voucher was awarded
WFO	Work for Others (WFO) was the predecessor to SPP. WFO was a policy to enable national labs, which are owned and directed by DOE, to partner on projects with other (non-DOE) entities.

Executive Summary

The Small Business Voucher (SBV) pilot, one of a handful of U.S. Department of Energy (DOE) programs within the National Laboratory Impact Initiative, is intended to accelerate the commercialization of clean energy technologies from small businesses by providing them access to staff and facility resources at DOE national laboratories (labs), with which they work to resolve technical issues that are hindering their innovations. The DOE Office of Energy Efficiency and Renewable Energy (EERE) provided roughly $20 million (fiscal year 2015) for the SBV pilot and launched the pilot March 23, 2015 with a request for lab participation.

This report, conducted by an independent evaluator, documents the pilot's design, first two rounds of voucher awards (through August 2016). It provides findings on early outcomes and a process assessment, identifies lessons learned, and offers recommendations. The longer-term outcomes for commercialization are not assessed in this evaluation, but is part of an ongoing evaluation effort. This report is based on findings from:

1. Interviews with lead lab pilot managers exploring lab baselines, pilot experiences and early outcomes,
2. Interviews with EERE SBV program manager and pilot managers at three of nine EERE Technology Offices – Advanced Manufacturing, Geothermal, and Buildings,
3. Onsite observation of the lead lab pilot planning meeting and of the subsequent debriefing held by lead lab pilot managers, and
4. Lab pilot proposals and other program documentation.

FINDINGS

Findings on Early Pilot Goal Attainment

As evidenced by the findings below for the pilot through Round Two awards, the pilot is reaching its goal of increasing small business access to, and engagement with, the labs.

1. **Small businesses gained awareness of the capabilities of the national laboratory system and the availability of lab technical resources to assist private firms.** The SBV website clearly described that the resources of the national lab system are available to the private sector. It clearly described the capabilities offered by each lab in the nine technology areas for which SBV offers vouchers. By the end of Round 2, 1,748 people registered at the pilot's Central Application Portal (CAP) and submitted 849 requests for assistance (RFAs). The

pilot received submittals from small businesses in 46 states and the District of Columbia for vouchers in all nine technology areas.

2. **Rounds One and Two of the pilot awarded 77 vouchers (9% of applicants) totaling $14.7M for innovative technology research.** About two-thirds of the vouchers were for cooperative research and development and one-third were for technical assistance. Voucher awards were most commonly in the ranges of $50,000 to $100,000, $150,000 to $200,000 and $250,000 to $300,000.
3. **Applicants and awardees included very small firms, young firms, and firms new to a lab relationship.** Two thirds of applicants were firms with less than six employees. Applicants had been in business an average of seven years, and awardees an average of eight years. Fifty-five percent of applicants and 32% of awardees had not previously worked with the lab. A correlation analysis of the merit review scores attained by applicants and their awareness of lab capabilities supports an interpretation that a small business with a good idea does not need to know much about the labs to have its application be judged meritorious.
4. **Development stages of applicants' and awardees' technologies fit the profile envisioned by EERE when planning the pilot.** About three-quarters of both groups requested assistance for technologies that had not reached the market and garnered sales. About half of the technologies of both groups had yet to be demonstrated as meeting the needs of the intended application. About one-quarter of the technologies of both groups had not reached the stages of having a tested prototype or having demonstrated feasibility in a lab setting. These findings are consistent with pilot objectives that vouchers would be used for such activities as intermediate scaling to generate samples for potential customers, validation of technology performance, and prototyping.
5. **Pilot processes made it easy for small businesses to participate.** Small businesses completed a short (about five-page) request for assistance, submitted the request through an application portal, and were notified of whether they were selected as a semi-finalist. The pilot matched the semi-finalists with the lab most appropriate to conduct the research, and the lab assigned a PI to the potential project. The PI worked with the firm to prepare a very brief presentation to the voucher decision-makers, which the lab presented on the firm's behalf. The pilot created standard research contracts to be used for all voucher awards. Small businesses knew the contract terms at the time of submittal and all parties agree to no negotiation of the terms.

Findings on Early Pilot Benefits

Lab pilot managers, Technology Offices pilot managers, and the EERE SBV pilot manager described several benefits from SBV.

1. **Participating lab pilot managers reported numerous benefits already attained through early pilot activities.** Interviewed lab pilot managers commonly attributed the pilot to increasing their knowledge of small business, one of the pilot's goals. Some lab managers stated that a few of the PIs for vouchers they were working on reported gaining insights that they would carry into their other research. Some lab managers described new non-SBV partnerships with small businesses that had resulted from the pilot.
2. **All three interviewed Technology Office pilot managers described multiple benefits to pilot participation.** The three managers stated they had awarded vouchers to unanticipated innovations not encompassed by their technology road maps. The managers also appreciated that SBV provided them with another mechanism for funding research.
3. **All interviewees credited the pilot with deepened, more productive relationships in multiple spheres.** The lab pilot managers described developing a strong, effective working relationship with the pilot managers from the other labs. Both the lab pilot managers and the Technology Office pilot managers described increased interactions between them; about half of the lab managers held the view that as a result of the pilot, they had a better understanding of what the Technology Offices wanted to attain with research projects. The Technology Office pilot managers described the benefit to the whole organization of cross-cutting efforts like SBV. Finally, the lab managers described forging new relationships with small businesses, supporting the pilot goal of increased engagement between the labs and small businesses.
4. **The pilot developed infrastructure that has the potential to continue to serve EERE's goals of increasing lab commercialization activities and engaging small businesses.** The SBV pilot has developed extensive, effective infrastructure that serves the small businesses interested in the vouchers, the labs that showcase their capabilities on the website, and the Technology Offices that benefit both from access to small business technology developments and from having Technology Office-funded research showcased through the labs' pages on the pilot website.

LESSONS LEARNED

Lessons Learned on Pilot Evolution

The pilot experienced substantial evolution both in implementation structure and processes and objectives served by voucher selection based on lessons learned along the way. The SBV Lab Call for pilot implementation requested labs to propose how their teams would design and implement a small business voucher program that coordinated with the programs of other selected lab teams so that participating small businesses had a common experience.

During the process of negotiating implementation contracts with the labs, EERE realized the labs needed to collaborate on a single program. Even so, EERE designated lead or co-lead labs for each technology area, expecting some variation among areas in internal lab processes (although maintaining a consistent small business-facing approach). Both the SBV Lab Call and the lab's implementation contracts indicated that the labs would conduct merit reviews within their technology areas of the RFAs using experts internal and external to the labs. The labs would then rank the proposals and recommend to the Technology Offices that they award vouchers to the highest-ranked requests.

EERE's Lab Impact Team then learned from the Technology Offices that they were not satisfied with this approach. Due to many factors, the Technology Offices wanted more information on more highly ranked requests than the labs initially provided them, and the offices selected requests for voucher awards among the top-quartile or so of applicants, rather than the top 8% or so initially presented by the labs.

Responding to Technology Office requests, EERE further modified aspects of pilot implementation for Round Two. It selected a single lab to implement the merit review process using exclusively external reviewers, most of which were identified by the Technology Offices. Rather than recommending to the offices requests to fund, the labs then presented for Technology Office consideration descriptions of the top-ranked quartile of applicants and the Technology Offices determined which vouchers to award.

The pilot continued to evolve based on lessons learned beyond the period covered by this evaluation.

Lessons Learned on Pilot Challenges

Although the pilot evolved, as described, in response to lessons learned by EERE during implementation, the evaluation identified numerous challenges, most of which still face the pilot and the remainder affecting early pilot performance.

1. Funding
    - **Topic area budgeted funds** – The Technology Offices are constrained to funding requests that align with the topic areas in which they are awarding vouchers.
    - **Funding amounts** – EERE needed to allocate pilot funding prior to the launch of any pilot activities, and thus the funding available for each technology and topic area did not correlate with the demand for vouchers in those areas.
    - **Tension between solving small business problems and addressing Technology Offices agendas** – The initial vision had the pilot awarding vouchers to the top-ranked requests consistent with available funding. The current approach awards vouchers to selected requests within the top-ranked quartile, consistent with both available funding and with Technology Office agendas for the topic areas.
    - **Administrative costs** – Pilot administrative costs were born by the Technology Offices, yet due to a variety of factors, the offices and labs did not experience the allocation by office to be commensurate to the services. In addition, EERE substantially underestimated pilot administrative costs. These factors degraded pilot efficiency and Technology Office satisfaction with the pilot as offices, labs, and Lab Impact staff needed to devote considerable time to payment of the lab's administrative costs. However, steps EERE took for FY2017 (outside the scope of this evaluation) address the issue.
    - **Funding source and release of funds to labs** – The pilot launched with FY2015 funding for planned implementation in FY2015 and FY2016, requiring Technology Offices and labs to hold back FY2015 funds to cover FY2016 costs. The Technology Offices differed in how they released funds to the labs. These factors degraded pilot efficiency and Technology Office satisfaction with the pilot as offices, labs, and Lab Impact staff needed to devote considerable time to these issues. However, steps EERE took for FY2017 (outside the scope of this evaluation) address the issues.
2. Technology Office differences
    - The pilot faces the situation of needing to work with what are essentially nine distinct organizations within EERE, the nine Technology Offices

awarding vouchers. The Technology Offices have varied considerably in their response to SBV, ranging from eager to very reluctant participants. Each office has its own policies, procedures, and cultures, and each office as demanded, to varying degrees, that pilot implementation adapt to meet its distinct needs. This situation challenges the pilot, which holds as an organizing principle the standard that small businesses experience a single, standardized program, regardless of the technology area or lab with which they work.

3. EERE support
    - **Executive commitment and norming within EERE** – Interviewed contacts among all three groups (the lead labs, EERE SBV pilot management, the Technology Offices) expressed the view that SBV lacked sufficient EERE Headquarters commitment. Contacts attributed the lack of understanding, indifference, and/or negative response to the pilot shown by most of the Technology Offices to lack of Headquarters endorsement of and attention to the pilot.
    - **Lab Impact Initiative management transitions** – From pilot conception to the end of Round One, the initiative experienced three Directors, the last of which continues to lead the initiative as of the writing of this report. The three Lab Impact Initiative Directors have held somewhat differing visions for the pilot, have had differing priorities and management styles, and have established differing pilot procedures.
4. Lead lab involvement
    - **Role of the lead labs** – The role of the lead labs changed substantially as pilot design and implementation evolved from the SBV Lab Call through Round Two awards. The SBV pilot is very complex; for example, the lead labs engaged in twelve distinct, multi-faceted activities (such as outreach, designing the open call for RFAs, and designing the merit review scoring system and process). EERE's original decentralized design gave way to a more centralized, and in some aspects more standardized, process as the inefficiencies of the extensive coordination required by a decentralized approach became apparent to EERE and the lead labs. Steps EERE took for FY2017 (outside the scope of this evaluation) address the issues.
    - **Technology Offices are the labs' clients** – The Technology Offices are the clients for most of the labs' work, which dwarfs in dollars and activity the SBV pilot. When faced with lack of understanding, indifference, and/or negative response by some Technology Offices, some of the lab pilot managers felt tension between their individual responsibilities to articulate

a pilot vision and uphold established pilot processes and their need to represent their organization appropriately to its largest clients

RECOMMENDATIONS

1. **DOE should continue SBV in roughly its current form – with appropriate resolution of existing challenges – after the pilot ends.** The pilot uniquely fills a niche created by DOE's objectives to stimulate the commercialization of clean energy technologies, stimulate economic activity, and ensure that the private sector – regardless of firm size – has access to the tax-payer funded, world-class national resource that of the national lab system. Interviewed Technology Office pilot managers indicated that SBV augments the mechanisms available to them to conduct R&D. DOE should reexamine the decision to continue SBV after SBV project outcomes and impact estimates are more fully assessed by the evaluation team in research through 2020. Current indications from early pilot experiences suggest that small businesses have the potential to reap benefits from their SBV projects.
2. **EERE should commit to SBV as a single, cross-cutting program that engages in a single set of small business-facing processes and timelines across all Technology Offices.** Continue to provide a simple and clear process whereby a small business can approach the labs with a request, have its request assessed on its merit, be matched with an appropriate lab and PI, and have a relatively simple contract developed and executed relatively quickly.
3. **EERE should develop and articulate its strategic vision for SBV.** One facet of the strategic vision might address key program benefits, such as providing access to the resources of the labs to the largest community within the private sector, that of small businesses, the knowledge transfer and relationship building it promotes among all parties, and identifying innovations not anticipated by the technology road maps. Another facet of the vision might be an articulation of how the Technology Offices can strategically deploy the various funding mechanisms at their disposal.
4. **EERE should continue the Technology Office-driven approach for vouchers, yet through its strategic vision and leadership, ensure that the research needs of both small businesses and the Technology Offices are met.** For example, the strategic vision might include SBV's role in identifying innovative, potentially high-impact technologies that are not considered in the offices' technology road maps. EERE leadership might consider requiring or strongly encouraging each office to award a few vouchers (a number relative to its total voucher awards) to such technologies. Alternatively, EERE might fund the Lab Impact Initiative to award vouchers to a handful of top-ranked requests

considered but not selected by the Technology Offices and ensure the offices provide these projects with the same technical and managerial attention they provide the projects they award.

5. **EERE leadership should provide greater direction to the Technology Offices regarding SBV and indicate that Headquarters wants to see its success.** EERE should require SBV participation of the nine Technology Offices. Headquarters should empower someone to enforce a single program, a program for which all small business-facing processes and timelines are the same across all Technology Offices, a program characteristic essential to its success. That person should step in to resolve SBV implementation conflicts between the Lab Impact Initiative team and the Technology Offices. EERE should provide Technology Offices' with metrics for or guidance on selection of vouchers that reflects its program strategy.
6. **With EERE leadership support, the Lab Impact Initiative team should increase its communication with the Technology Offices, and engage the labs in thinking more strategically about the top ranked RFAs.** The Lab Impact team should continue to communicate the strategic vision for SBV and voucher selection to the Technology Offices. The EERE SBV pilot manager should help the lab staff engaged in presenting RFAs to the offices to consider the requests from a strategic perspective and persuasively present to the offices reasons why they should invest in a given RFA.
7. **The Lab Impact Initiative team, working with the Technology Offices, should assess the benefits of offering fewer vouchers over $200,000** (one-third of the Round One and Two vouchers). Given a limited SBV budget and the high demand for vouchers, the program must make a trade-off between number of vouchers and average size of voucher. While these higher amounts may indeed be fully appropriate to the requested research and necessary to attain the intended benefits, it may instead by the case that many of these small businesses could achieve significant outcomes with less funding. If the latter scenario holds true, were SBV to award fewer vouchers in excess of $200,000, more vouchers could be awarded. Results from the SBV impact evaluation due 2020 should inform this assessment.
8. **Revisit the Lead Lab program implementation structure.** It appears that program implementation might be streamlined were EERE to work with a central implementation lab, extending an invitation to the other participating labs to be on an advisory council. However, it also appears for multiple reasons that EERE should continue to support the lead labs in conducting program outreach. Among other reasons for this support, the labs' SBV outreach activities complement the broader EERE objective for the labs that they become active participants in the

commercialization of innovative activities. Regardless of the ultimate implementation structure, all program roles and responsibilities should be clarified and understood by all parties to the program – the Lab Impact team, the labs, and the Technology Offices.

Section 1 Introduction

The Small Business Voucher (SBV) pilot, one of a handful of U.S. Department of Energy (DOE) programs within the National Laboratory Impact Initiative, is intended to accelerate the commercialization of clean energy technologies from small businesses by providing them access to staff and facility resources at DOE national laboratories (labs), with which they work to resolve technical issues that are hindering their innovations. The DOE Office of Energy Efficiency and Renewable Energy (EERE) provided roughly $20 million (fiscal year 2015) for the SBV pilot and launched the pilot March 23, 2015 with a request for lab participation.

This report, conducted by an independent evaluator, documents the pilot's design, first two rounds of voucher awards (through August 2016). It provides findings on early outcomes and a process assessment, identifies lessons learned, and offers recommendations. The longer-term outcomes for commercialization are not assessed in this evaluation, but is part of an ongoing evaluation effort. This report is based on findings from:

1. Interviews with lead lab pilot managers exploring pilot experiences and early outcomes,
2. Interviews with EERE SBV program manager and pilot managers at three of nine EERE Technology Offices – Advanced Manufacturing, Geothermal, and Buildings
3. Onsite observation of the lead lab pilot planning meeting and of the subsequent debriefing held by lead lab pilot managers, and
4. Lab pilot proposals and other program documentation.

1.1 SMALL BUSINESS VOUCHER PILOT OVERVIEW

The SBV pilot offers U.S.-based and -owned small businesses in the clean energy sector the opportunity to receive world-class, tailored technical assistance in bringing their next-generation technologies to market. The pilot awards vouchers to competitively-selected small businesses, defined as those that employ fewer than 500 people. The vouchers enable small businesses to access national lab staff expertise and specialized equipment that are not readily available in the private sector. The pilot aims to support new technology development by small businesses, bolster U.S.-based clean-energy efforts through public-private partnerships, and create jobs. As of November 2016, the time of the writing of this preliminary evaluation, DOE had awarded 76 small businesses nearly $15 million in vouchers over two rounds of open calls for requests for assistance (RFA), and a third-round open call had just closed.

The goals of the pilot and a potential broader SBV program include:[1]

- Increase engagement between the labs and small businesses that have high growth potential by providing targeted access and services to further EERE's mission,[2]
- Broaden lab awareness of small business technological development and technical needs,
- Encourage labs to recognize and assist with the successful commercialization of potential technologies across a wide spectrum of application areas, and
- Strengthen U.S. economic competitiveness in high-technology industries to support small business development and job creation.

EERE, through a competitive lab call selection process, selected five national labs to lead the effort (termed "lead labs"):

- Lawrence Berkeley National Laboratory (LBNL)
- National Renewable Energy Laboratory (NREL)
- Oak Ridge National Laboratory (ORNL)
- Pacific Northwest National Laboratory (PNNL)
- Sandia National Laboratories (SNL)

EERE, in a separate negotiation, selected one of these labs, to develop a central application platform (CAP) for all small businesses to use to submit an RFA for any technology area or any lab.[3] (This lab is referred to as the CAP lab). Small businesses have the option of requesting a specific lab to work with; alternatively, they can leave this field blank. As part of the vision of offering small businesses a one-stop shop for all aspects of the pilot, the CAP lab executed the creation of the pilot website, sbv.org, that provides all pilot information, as well as the application portal.[4]

The pilot seeks RFAs from small businesses seeking to partner with labs to solve technical challenges they face in their efforts to bring innovations to market. The selected businesses receive vouchers for $50,000 to $300,000 each.[5] The lead labs collaborate to pair each selected business with a lab and principal investigator or project

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[1] *Small Business Vouchers Pilot Laboratory Call for Proposals,* March 23, 2015. Hereafter, "SBV Lab Call."

[2] The mission of the EERE is to create and sustain American leadership in the transition to a global clean energy economy. Its vision is a strong and prosperous America powered by clean, affordable and secure energy. *http://energy.gov/eere/about-us/mission*

[3] EERE had initially intended to use a competitive process to select the CAP lab, yet when faced with time constraints, instead discussed capabilities with several labs. EERE selected NREL, which planned to use software the lab was already familiar with – Ideascale "innovation management" software (www.ideascale.com). Source: *SBV Lab Call Q&A.*

[4] The CAP lab executed the framework, design, and content developed by another lead lab.

[5] Vouchers are estimated to provide between six weeks to one year full-time-equivalent research time. A small business may receive more than one voucher but no more than $300,000 in voucher funding.

manager to provide the requested assistance. The paired lab is chosen from among 13 national labs as the lab best positioned to conduct the research.[6] Businesses are not restricted to working with the lead labs; the "lead" designation signifies the labs' role in pilot implementation, not in voucher work. A few businesses have been paired with two labs for their voucher work, rather than a single lab; these RFAs were best addressed by the complementary activities of two labs.

Participating businesses may use their vouchers for up to 12 months of work at the paired national lab. The selected businesses are required to contribute a minimum of 20% to the overall project cost (more if closer to development): businesses' contributions to the cost-share may be in the form of in-kind labor, materials, equipment, data, or travel.[7]

Vouchers are available for the critical technical challenges of small businesses relating to every EERE Technology Office; each office designates the specific topic areas for which it will award vouchers. Table 1-1 gives SBV funding caps by technology area.[8]

[6] In addition to the lead labs, small businesses can partner with Ames Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, Fermi National Accelerator Laboratory, Idaho National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Savannah River National Laboratory.

[7] Cost-share requirements are statutory. Energy Policy Act (EPAct) of 2005, Section 988.

[8] The budgets cover both vouchers and SBV administrative costs incurred by the lead labs. Lab pilot administrative costs include developing pilot processes, developing and updating the pilot website, conducting pilot outreach, conducting the merit review of submitted RFAs, and working with the Technical Offices to select awardees. In addition to the funding amounts shown in the table, total pilot funding includes money for the development of the web-based program platform for accepting RFAs and for pilot evaluation, bringing the total SBV pilot funding to about $20 million.

Table 1-1: SBV Topic Areas and Initial Pilot Funding Caps*

Topic Area	Funding Covers	Funding Cap ($ millions)
Advanced Manufacturing	Next-generation materials to render factory processes cleaner and smarter	$4.4
Bioenergy	Research and development of renewable biomass resources into commercially viable, high-performance biofuels, bioproducts, and biopower	$2.1
Buildings	Products that reduce energy use or provide demand side management and interoperability in residential and non-residential buildings	$1.9
Fuel Cells	Fuel cell materials and performance; hydrogen production, delivery and infrastructure technology, storage; manufacturing; infrastructure analysis	$2.9
Geothermal	Products that harness energy from enhanced geothermal systems, low temperature geothermal, or geothermal systems analysis	$1.4
Solar Energy	Products and services associated with photovoltaics, balance of system, systems integration, concentrating solar power, and technology to market	$1.0
Vehicles	Products that produce cleaner, more efficient transportation in: advanced combustion engines; battery research and development (R&D); electric drive R&D; vehicle systems; lightweight and propulsion vehicle materials; or vehicle fuels and lubricants	$2.4
Water Power	Products using waves, tides, and waterways for environmentally safe power in: marine and hydrokinetics, or hydropower	$2.2
Wind Energy	Products that advance distributed wind or utility-scale wind	$1.0
Total		**$18.3**

Sources: Descriptions from sbv.org. Funding amounts from U.S. Department of Energy National Laboratory Network Notice of Opportunity: Small Business Vouchers (SBV) Request for Assistance (RFA) – the Notice of Opportunity for Round One.

The pilot awards vouchers for such activities as:[9]

- Prototyping
- Materials characterization
- High performance computations
- Modeling and simulations
- Intermediate scaling to generate samples for potential customers
- Validation of technology performance
- Designing new ways to comply with regulations

EERE seeks to award small businesses with high impact potential, that is, to fund research that will hasten the commercialization of next-generation clean energy technologies with the potential to advance the clean energy economy through important innovation, substantial product sales, and increased employment.

The pilot comprises multiple rounds of competitions; Round One opened for RFAs in September 2015, Round Two opened in March 2016, and Round 3 (not addressed in this evaluation) opened in October 2016.[10] Each round is initiated with pilot outreach inviting small businesses to apply. The small businesses apply by submitting a short (about five-page)[11] RFA that includes descriptions of: (1) the company, (2) the technical challenge faced and how the requested assistance would help to overcome the challenge, (3) the potential project impact (such as cost savings or increased performance; issues related to DOE EERE mission areas), (4) how the company will use the project results, (5) key company team members, and (6) how the firm will provide the required 20% cost share. As part of the application process, the company needs to register on the CAP portal and complete a few steps, including providing contact and other requested information.

The lead labs and the Technical Offices work together in a process that includes eligibility screening and merit review of RFAs, ranking of RFAs by merit score, matching of small businesses to labs, and development for meritorious RFAs of outlines of work statements that suggest how the project would unfold.[12] The process concludes with the

[9] U.S. Department of Energy National Laboratory Network Notice of Opportunity: Small Business Vouchers (SBV) Request for Assistance (RFA) – the Notice of Opportunity for Round One.

[10] The pilot launched with about $20 million in FY2015 funding and the intention to conduct up to three rounds of RFA voucher awards, contingent on funding remaining after the prior round. EERE subsequently added FY2017 money to the SBV pilot, augmenting the FY2015 funding remaining for Round 3 and enabling a fourth open call round.

[11] The page length restriction has varied slightly across rounds. Round One RFAs were limited to five pages of text, two pages of supporting documentation (such as graphs, tables, and images) presented in an appendix, and three resumes. Round Two RFAs were limited to four pages of text, including graphs, tables, and images, and three pages of supporting documentation consisting of resumes and/or support letters.

[12] Although the pilot awarded vouchers to about 9% of firms submitting RFAs, many more RFAs were judged to be of sufficient quality as to potentially warrant a voucher were substantially more funding available. One knowledgeable lab pilot manager estimated that about half the RFAs received had some merit – that is, described a technical

DOE Technology Offices awarding the vouchers to selected small businesses. This review and selection process has evolved during the pilot and is described in more detail in Section 4.

Table 1-2 provides the timeline for the SBV pilot through the end of the evaluation period.

Table 1-2: SBV Pilot Timeline through End of Evaluation Period

Date	Description
2014	EERE SBV concept and program plan developed
Fall 2014	EERE provided $20 million (fiscal year 2015) to launch the SBV pilot
Fall/Winter 2014-2015	EERE worked with DOE Site Offices, the labs, and other stakeholders to develop two standard agreements for all SBV awards – an SBV CRADA (Cooperative Research and Development Agreement) and SBV TAPA (Technology Assistance Pilot Agreement)
March 23, 2015	Laboratory Call for Proposal for labs to serve as lead labs in the SBV pilot
April 26, 2015	Submission date for lead lab pilot proposals
May 2015	DOE conducted merit review of lead lab proposals
May 22, 2015	Merit Review Advisory Report submitted by independent reviewers to EERE
July 8, 2015	EERE announced selection of lead labs during the Clean Energy Manufacturing Initiative's Southeast Regional Summer
August 4-5, 2015	Lead labs met with EERE managers to begin designing pilot processes

challenge for which a solution might yield technology innovation, which in turn might have commercialization potential. For both rounds of the open call, experts scored each RFA on its merits and the lead labs ranked the RFAs in decreasing order by merit score. For both rounds, the Technology Offices received the scores and rankings of all RFAs and then more closely examined what they determined to be the upper tiers, from which they made their final selections. The details of the selection process differed between the two rounds. The description given here corresponds with the Round Two process. For Round Two, the labs developed sketches of work statements for the top quartile (25%) of RFAs. Because the proportion of RFAs carefully considered for vouchers differed both between rounds and among the Technology Offices, the report uses the term *meritorious* in the general sense of having some merit. The term as used in this report does not correspond to a specific proportion.

Date	Description
September 23, 2015	SBV begins accepting Round One RFAs from small businesses. EERE announced the launch of the pilot website during EERE's Industry Day event at ORNL
October 23, 2015	Submission deadline for Round One small business RFAs
November 20, 2015	DOE and lead lab pilot managers debriefing meeting on Round One pilot processes to date
December 22, 2015	The first of Round One negations with small business to award vouchers began
January 26, 2016	The first Round One contract was signed
March 10, 2016	DOE announced selection of 33 small businesses to participate in SBV Round One
March 10, 2016	SBV begins accepting Round Two RFAs
April 10, 2016	Submission deadline for Round Two small business RFAs
August 18, 2016	DOE announced selection of 43 small businesses to participate in the second round of SBV pilot
August 19, 2016	The last Round One SBV contract was signed
November 2016*	The last Round Two SBV contract was signed

* Exact date not available to the evaluators at the time of this report.

This SBV evaluation study of Rounds One and Two began in August 2015, with data collection ending November 2016. Round 3 opened for RFAs on September 23 and closed November 14, 2016. EERE added $12 million in FY2017 funding to the pilot to augment the remaining FY2015 funding available for Round 3 vouchers and to conduct a Round 4.

1.2 CONTEXT FOR THE SBV PILOT

The DOE national labs are home to world-class scientists, engineers, and managers and house unique, advanced instruments. These intellectual and technical assets have solved critical national challenges and originated many inventions and other intellectual property that have significantly improved human lives. The labs partner with private sector firms through such mechanisms as CRADAs, Technical Assistance (TA) Agreements, Work for Others (WFO) Agreements, and Agreements for Commercializing

Technology (ACT), among others (see **Error! Reference source not found.**).[13] Through the Lab Impact Initiative, launched in December 2013, EERE aims to substantially increase the impact the national labs have on the U.S. clean energy sector.

The approximately 23 million small businesses in the U.S. comprise 99% of employers, employ 55% of the workforce, have been responsible for 66% of all net new jobs since the 1970s, and since 1990 have added 8 million new jobs, compared with 4 million added by large businesses.[14] Despite their large market presence, small businesses partner with the labs less frequently than larger enterprises. For both FY2013 and FY2014, small business proportion of CRADAs was just over one-third (37%), up from one-third (33%) in 2002.[15] Small businesses can use awards from the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs to access lab resources, and yet less than 10% of DOE SBIR and STTR grant awardees collaborate with the labs.[16]

The SBIR awards provide early-stage funding to assist small businesses in creating new technologies; little federal support is available to help validate the technology's performance for an application; without such validation, the business is unlikely to attract follow-on private sector funding. Research has shown that small businesses have difficulty marshalling the resources to build and iterate on prototypes, generate sufficient samples for certification, or complete regulatory required licensing, as illustrated in Figure 1-1.

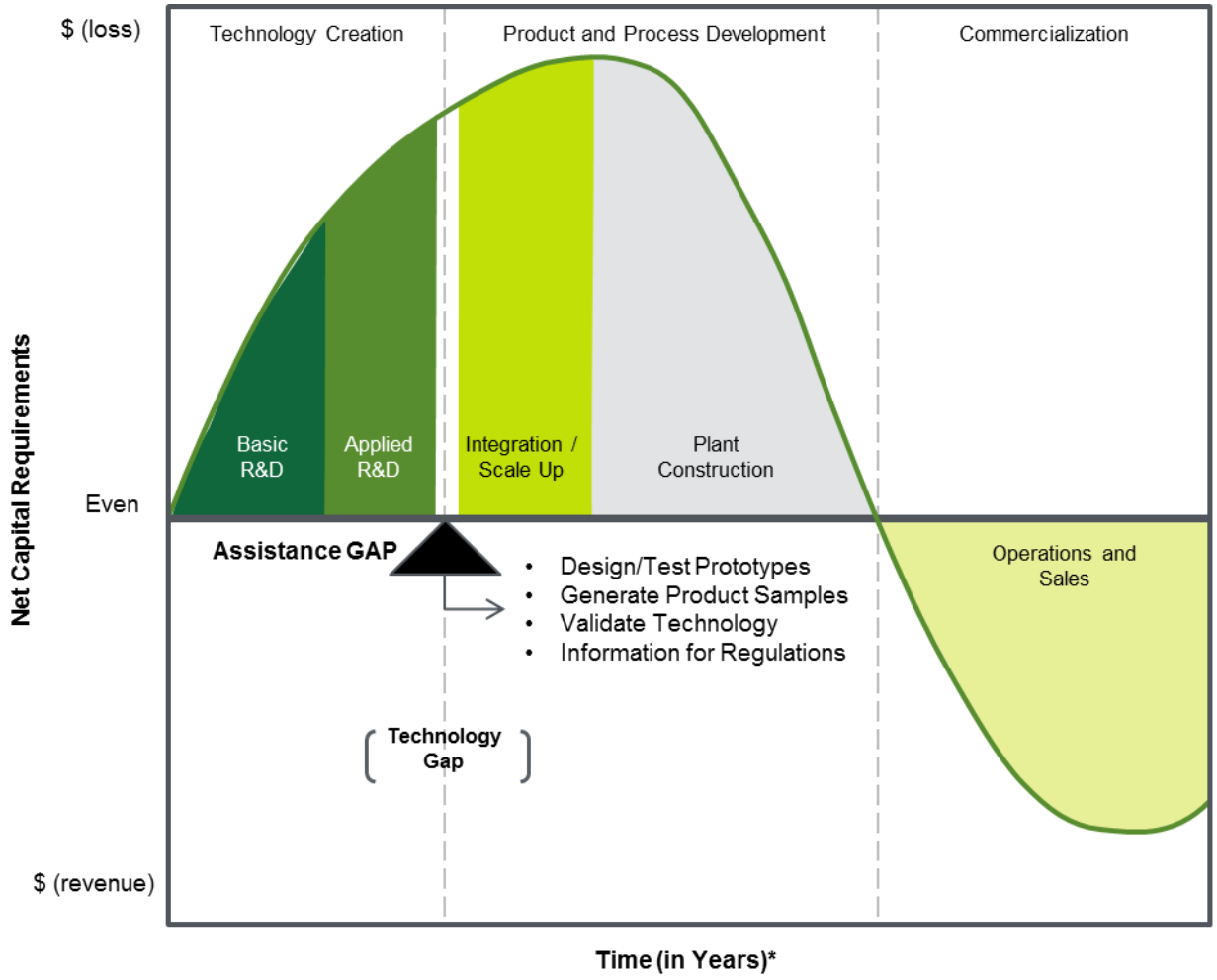
[13] Other mechanisms include User Agreements, Technology Licensing Agreements, Material Transfer Agreements (MTA), and Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR). Source: *Guide to Partnering with DOE's National Laboratories.*

[14] D'Amico, et al. 2013. "Building a Bridge across the Transition Chasm." IEEE Security & Privacy. 11:24.

[15] Source of FY2013 and FY2014 statistics: *SBV_LessonsLearned_Yang_20141120*: receive through private communication. Source of FY 2002 statistic: *Small Business Vouchers Pilot Laboratory Call for Proposals,* March 23, 2015.

[16] Most awardees use their SBIR and STTR awards to access university support. Source: *SBV Lab Call*.

Figure 1-1: Assistance Gaps

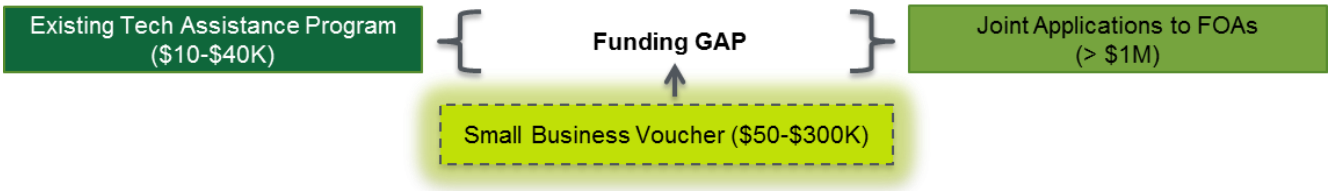


Source: National Research Council. 2008. *An Assessment of the SBIR Program*. Washington, DC: The National Academies Press.

Several of the labs have been working with small businesses for the past decade or so to provide them access to lab resources to validate technologies and other support, yet these resources are limited in both the assistance available to an individual small business (award sizes may be on the order of $10,000 or 40-hour equivalent) and in the total number of businesses that can be assisted each year (total program funding). The SBV pilot builds on these validated programs, including New Mexico Small Business Assistance program supported by Los Alamos National Laboratory (LANL) and SNL, the Technical Assistance Programs of Idaho National Laboratory (INL) and PNNL, and NREL's Commercialization Assistance Program. At the other end of the funding spectrum, some labs are working with small businesses on projects attained through joint (lab-small business) applications to Funding Opportunity Announcements (FOAs).

EERE designed the SBV pilot to fill an identified gap in funding for mid-size projects, as illustrated in Figure 1-2.[17]

Figure 1-2: Funding Gaps



Source: National Research Council. 2008. *An Assessment of the SBIR Program*. Washington, DC: The National Academies Press.

Studies have identified challenges that impede small business engagement with the labs.[18] From the small business perspective, they have limited awareness that the labs partner with the private sector, the types of resources the labs offer in aggregate, the specific research areas, expertise, and facilities each lab provides, and who to contact at the lab for help in identifying possible partnering opportunities and processes for pursuing them. Further, those small businesses with awareness, interest, and knowledge of appropriate potential partnerships need to have the funds to cover the costs of the lab services sought. Finally, those small businesses able to partner need to work with the labs to develop statements of work and agree to the terms of CRADAs, technology assistance agreements, and other agreements. This activity can be time-consuming – both in terms of staff requirements (possibly including legal assistance) and in elapsed time (typically many months; likely not at "the speed of business"). It can also be frustrating, because the labs themselves have limited freedom to negotiate the terms of technology transfer agreements. The labs, in turn, lack relationships with small businesses through which they might work to increase awareness of partnering opportunities and do not have procedures to match small businesses with the appropriate lab researchers and facilities.[19]

[17] *Small Business Vouchers Pilot Laboratory Call for Proposals,* March 23, 2015. *DOE Small Business Voucher Pilot White Paper,* January 2015. Provided to the evaluation team by the Lab Impact Initiative. Program URLs: *http://www.nmsbaprogram.org; http://www.pnl.gov/edo/assistance/techassist.stm; https://inlportal.inl.gov/portal/server.pt/community/technology_transfer/269/technical_assistance_program; and http://www.nrel.gov/technology transfer/ncap.html*.

[18] All firms face these challenges; studies have shown that larger firms more successfully negotiate these challenges.

[19] *Small Business Vouchers Program Plan Version 2.0,* September 2014; received through private communication.

Given these factors –

- The importance of small businesses in innovation and job creation,
- The unparalleled resources of the national labs – resources developed largely through taxpayer funding,
- EERE's efforts to increase the labs' commercial impacts and industry engagement, and
- The relatively small proportion of lab-small business partnerships – the labs themselves proposed to EERE that it make available vouchers for small businesses to access lab resources.[20] EERE developed the pilot based on input from a public workshop, the labs, DOE SBIR Program, small businesses, the State Energy Advisory Board (an EERE Federal Advisory Committee), and outside stakeholders, as well as lessons learned from the lab small business programs described above.[21]

[20] "Conceptualized by the National Laboratory Director's Council and developed by the DOE's EERE and the Under Secretary for Science and Energy, the EERE National Lab SBV pilot intends to further DOE's clean energy and economic development missions by increasing small business access to the expertise, competencies, and infrastructure of DOE's National Labs." *DOE Small Business Voucher Pilot White Paper,* January 2015, received through private communication.

[21] *DOE Small Business Voucher Pilot White Paper,* January 2015, received through private communication.

Section 2 Methods

The goals of the pilot and a potential broader SBV program include: [22]

- Increase engagement between the labs and small businesses that have high growth potential by providing targeted access and services to further EERE's mission,
- Broaden lab awareness of small business technological development and technical needs,
- Encourage labs to recognize and assist with the successful commercialization of potential technologies across a wide spectrum of application areas, and
- Strengthen U.S. economic competitiveness in high-technology industries to support small business development and job creation.

The first three goals are near term goals.

This evaluation:

- Establishes a **baseline** of technology transfer activities and attitudes prior to participation in the SBV pilot
- Assesses **early outcomes** per the pilot's three principal near-term goals:[23]
    - **Engagement of small businesses:** Assess the extent to which the pilot increased engagement between labs and small businesses to further EERE's mission,
    - **Lab awareness:** Assess the extent to which the pilot broadened lab awareness of small business technological development and technical needs, and
    - **Lab commercialization assistance:** Assess the extent to which the pilot encouraged labs to recognize and assist small businesses with the successful commercialization of a wide spectrum of potential technologies.
- Documents and assesses pilot processes:
    - **Document:** Document pilot design and implementation,
    - **Lessons Learned:** Identify pilot approaches associated with pilot success, and
    - **Opportunities:** Identify opportunities for improving SBV.

[22] *Small Business Vouchers Pilot Laboratory Call for Proposals,* March 23, 2015.

[23] Not addressed in this evaluation are pilot long-term goals, including the fourth pilot goal to support small business development and job creation.

2.1 OVERVIEW OF METHODS

This report is based on findings from:

1. Interviews with five lead-lab pilot manager teams exploring lab baselines, pilot experiences and early outcomes,
2. Interviews with EERE SBV program manager and pilot managers at three Technology Offices – Advanced Manufacturing, Geothermal, and Buildings,[24]
3. Onsite observation of the lead lab pilot planning meeting August 4-5, 2015 and of the Round One debriefing meeting (November 20, 2015) held by lead-lab pilot manager teams, and
4. Review of lab pilot proposals, pilot planning documents, pilot website (sbv.org), lead-lab committee meeting agendas, and other program documentation.

This report is the first in a five-year study of SBV pilot impacts.

The team will complete interim progress reports in 2017, 2018 and 2019. These reports will be based on web-surveys as well as data collected by the labs from the participating small businesses. The surveys will be implemented in the spring of each year. The survey conducted in the spring of 2017 will include three populations: Round One projects, which will have ended, as SBV projects are limited to 12-months duration; Round Two projects, which will have completed about half of their voucher work, as their vouchers were announced in August 2016; and a comparison group of nonparticipants defined as applicants that submitted RFAs that were not awarded vouchers. The surveys conducted in the spring of 2018 and 2019 will be limited to SBV participants (all rounds) and will provide tracking data on SBV pilot impacts such as commercialization and other outcomes.

For the final report, we will conduct a final survey with all SBV participants as well as the comparison group of nonparticipants in the spring of 2020. We will also be reporting on interviews with lab researchers that worked with the small businesses on their voucher projects, and follow-up interviews with the lead-lab pilot manager teams.

Last, for the final report, we will benchmark outcomes and degree of program influence with selected DOE SBIR Phase I projects and calculate benefit-cost ratios for commercial successes for both the SBV and SBIR Phase I groups and compare these

[24] The interviewed managers conducted SBV coordination within their Technology Offices. More broadly, they were responsible for technology transitions, including small business engagement.

for the final report.[25] This comparison will be based on the corresponding project data from the 2010 survey of DOE SBIR recipients.

2.2 EARLY OUTCOME METRICS AND DATA SOURCES

The peer-reviewed technical evaluation plan established performance metrics for assessing SBV early outcomes in the areas of engagement of small businesses, lab awareness, and commercialization assistance (Table 2-1).[26] The table also identifies our data sources.

Table 2-1: Early Outcome Metrics and Data Sources

Outcome Area	Metric	Data Sources
Engagement of small businesses	Increased lab outreach to small business	Lab pilot manager team interviews, document review
	Number of registered CAP users	Lab pilot manager team interviews, SBV database and document review
	Number of RFAs submitted	SBV database
	Number of vouchers awarded	SBV database
	Amount of voucher funding awarded	SBV database
	Number of technical assistance agreements signed	SBV database
	Number of cooperative research and development agreements signed	SBV database
	Shortened time to match principal investigator to project request	Lab pilot manager team interviews
	Shortened time to develop statement of work	Lab pilot manager team interviews

[25] SBIR Phase I selected in discussion held between the SBV pilot manager and DOE's SBIR program manager as most comparable to SBV, given the size of the vouchers. Source: March 4, 2015 interview with Zack Baize.

[26] *Small Business Vouchers Pilot Technical Evaluation Plan,* August 20, 2015. Submitted to US DOE EERE by NMR Group, Inc., Research Into Action, Inc., Gretchen Jordan, Ph.D., Albert Link, Ph.D., and East Mountain IP. Peer-reviewed by Donald Siegel, Ph.D., Irwin Feller, Ph.D., Brian Zuckerman, Ph.D., Maryann Feldman, Ph.D., and Lori Lewis, Ph.D.

Outcome Area	Metric	Data Sources
	Shortened time for DOE and lab staff to complete agreement execution approval processes (once statement of work completed)	Lab pilot manager team interviews
	Satisfactoriness of standard contracts to small businesses and labs	Lab pilot manager team interviews
	Lab satisfaction with engagement processes	Lab pilot manager team interviews
Lab awareness of small business technical needs	Number of labs reviewing meritorious RFAs	Lab pilot manager team interviews
	Number of meritorious RFAs reviewed	Lab pilot manager team interviews
Lab commercialization assistance	Number of labs applying for lead lab role	SBV document review
	Number of labs selected as lead labs	SBV document review
	Number of labs offering voucher assistance by technology area	SBV document review
	Number of labs providing voucher assistance by technology area	SBV document review

2.3 SOURCES USED TO DOCUMENT AND ASSESS PILOT PROCESSES

Table 2-2 identifies the data sources used to document and assess pilot processes.

Table 2-2: Data Sources for Pilot Process Documentation and Assessment

Document and Assess Program Processes	Areas of Investigation	Lab Pilot Manager Team Interviews	EERE SBV Manager Interview	EERE Tech Office Manager Interview	SBV Database and Document Review	Onsite Observation
Document Pilot	Pilot design	✓	✓	✓	✓	✓
	Pilot implementation	✓	✓	✓	✓	✓
	Pilot outcomes	✓	✓	✓	✓	✓
Identify Lessons Learned and Opportunities for Improvement	Approaches to RFA merit review	✓	✓	✓	✓	✓
	Approaches to lab partner selection	✓	✓	✓	✓	
	Approaches to other pilot processes	✓	✓	✓		✓
	Pilot and non-pilot support provided; related lab policies/ programs	✓			✓	
	Lab satisfaction with Lab Call, selection, and participation; positive perception; intention to continue	✓			✓	✓
	Recommendations offered	✓	✓	✓		✓
	Fit of SBV with lab environment	✓			✓	

2.4 LATER OUTCOME METRICS AND DATA SOURCES

Our subsequent research will address later pilot outcome metrics. Table 2-3 provides the metrics and our data sources.

Table 2-3: Later Outcome Metrics and Data Sources

Outcome Area	Metric	Data Sources
Engagement of small businesses	Satisfaction of small businesses with website; knowledge gain; ease of use	Participant and nonparticipant surveys
	Satisfaction of small businesses with application process	Participant and nonparticipant surveys
	Satisfaction of small businesses with contracting process	Participant survey
	Satisfaction of small businesses with partnership experiences	Participant survey
	Satisfaction of small businesses with quality of work provided	Participant survey
	Proportion of small businesses interested in repeated work with lab	Participant survey
	Proportion of small businesses recommending to colleagues	Participant survey
	Satisfaction of lab staff with partnership experiences	Lab staff interviews
	Shortened time to start work once agreements executed	Lab staff interviews/ tracking data
	Increase in number of lab-small business partnerships (such as CRADA, WFO/ Strategic Partnership Projects (SPP), Material Transfer Agreement [MTA])	Lab tracking data
	Increase in small businesses using specialized laboratory facilities or equipment	Lab tracking data

Outcome Area	Metric	Data Sources
Lab awareness of small business technical needs	Numbers of lab personnel at all levels of the organization engaged in small business technology assistance or collaborative R&D partnerships	Lab staff interviews
Lab commercialization assistance	Proportion of small businesses whose knowledge/skills increased through lab engagement	Participant survey
	Small business assessment of value of lab engagement	Participant survey
	Number of small businesses reporting technical hurdle overcome	Participant and nonparticipant surveys
	Proportion of small businesses for which Intellectual property (IP) was created or licenses obtained	Participant and nonparticipant surveys; CRADA comparison
	Proportion of small businesses for which technology readiness advanced	Participant and nonparticipant surveys; CRADA comparison
	Proportion of small businesses obtaining additional investment	Participant and nonparticipant surveys; CRADA comparison
	Proportion of small businesses with pilot technologies commercially launched	Participant and nonparticipant surveys; CRADA comparison
	Number of startup companies	Participant and nonparticipant surveys; CRADA comparison
	Proportion of small businesses adding staff due to technology; quantity of staff added	Participant and nonparticipant surveys; CRADA comparison
	Number of small businesses with reduced costs or increased revenues due to pilot technology	Participant and nonparticipant surveys; CRADA comparison

Outcome Area	Metric	Data Sources
	Number of small businesses reporting emissions reductions due to pilot technology; quantity of reductions	Participant and nonparticipant surveys

2.5 PILOT LOGIC MODEL

The evaluation team developed a logic model of the SBV Pilot from its inception through implementation, illustrating how the pilot's activities will achieve its one year and broad goals. Appendix A provides more detailed pilot logic models, including those for EERE (that is, Headquarters), the lead labs, and the participating small businesses.

The four principal SBV goals are seen in the bottom row of the high-level logic model shown in (Figure 2-1). Beginning with the end in mind, the goals of the pilot and a potential broader SBV pilot, as stated in the SBV Lab Call, are the following:[27]

- Increase engagement between Laboratories and small businesses (abbreviated in the logic model as SBs) that have high growth potential by providing targeted access and services to further EERE's mission,
- Broaden Laboratory awareness of private-sector technological development and technical needs in small businesses that are developing new technical applications,
- Encourage Laboratories to recognize and assist with the successful commercialization of potential technologies across a wide spectrum of application areas, and
- Strengthen U.S. economic competitiveness in high-technology industries to support small business development and job creation.

For the purposes of this evaluation, these end goals are restated in measurable terms:

- Lab management and staff are aware of current clean energy small business development and technical needs,
- Labs provide funding and access to Laboratory expertise and services to an increasing number and mix of clean energy small businesses and applications, and

[27] *Small Business Vouchers Pilot Laboratory Call for Proposals,* March 23, 2015.

- Small businesses working with the labs develop clean energy products and processes, and many commercialize and sell these, growing the company and contributing to EERE's core energy, environment and economic goals.

These end goals are seen in the bottom row of the high-level logic model shown in Figure 2-1. The top row shows the activities of EERE staff and the information technology (IT) platform that the CAP lab developed to support outreach and the application submittal and scoring processes. The second row from the top shows what the lead labs do with funds from EERE, and the third shows what voucher firms do with assistance from the lab. Each of these are explained in more detail.

The activities of EERE that reflect the strategies assumed to increase engagement and accelerated technology development are grouped into four areas:

- EERE designs the pilot in response to requests by the labs, modeling it after validated existing programs and seeking DOE General Counsel and public input.
- EERE standardizes with the labs and DOE Site Offices agreements for cooperative research and technical assistance to make application easier for small businesses and to shorten the time taken by all parties to approve contracts, as the pilot does not permit modification of the terms of the agreements.
- EERE issues the SBV Lab Call with clear program goals and selection criteria. EERE selects the labs using merit review.
- EERE funds the development of an application portal that makes it easier for small businesses to learn about lab capabilities and to apply for the voucher program. The expert reviewers also use the portal to score the RFAs (merit review).

The response to EERE actions and funding for the selected (lead) labs are outcomes of those EERE activities. The four groups of lab activities that reflect the strategies assumed to increase engagement and accelerated technology development, are:

- Labs determine the approach they will take to engagement with small business and began outreach. Implementation includes outreach materials, events, and engagement of intermediaries to reach more small clean energy businesses than in the past.
- Labs develop and implement processes for selecting voucher proposals[28] and assign staff to work with the winning firms to develop and implement statements of work.

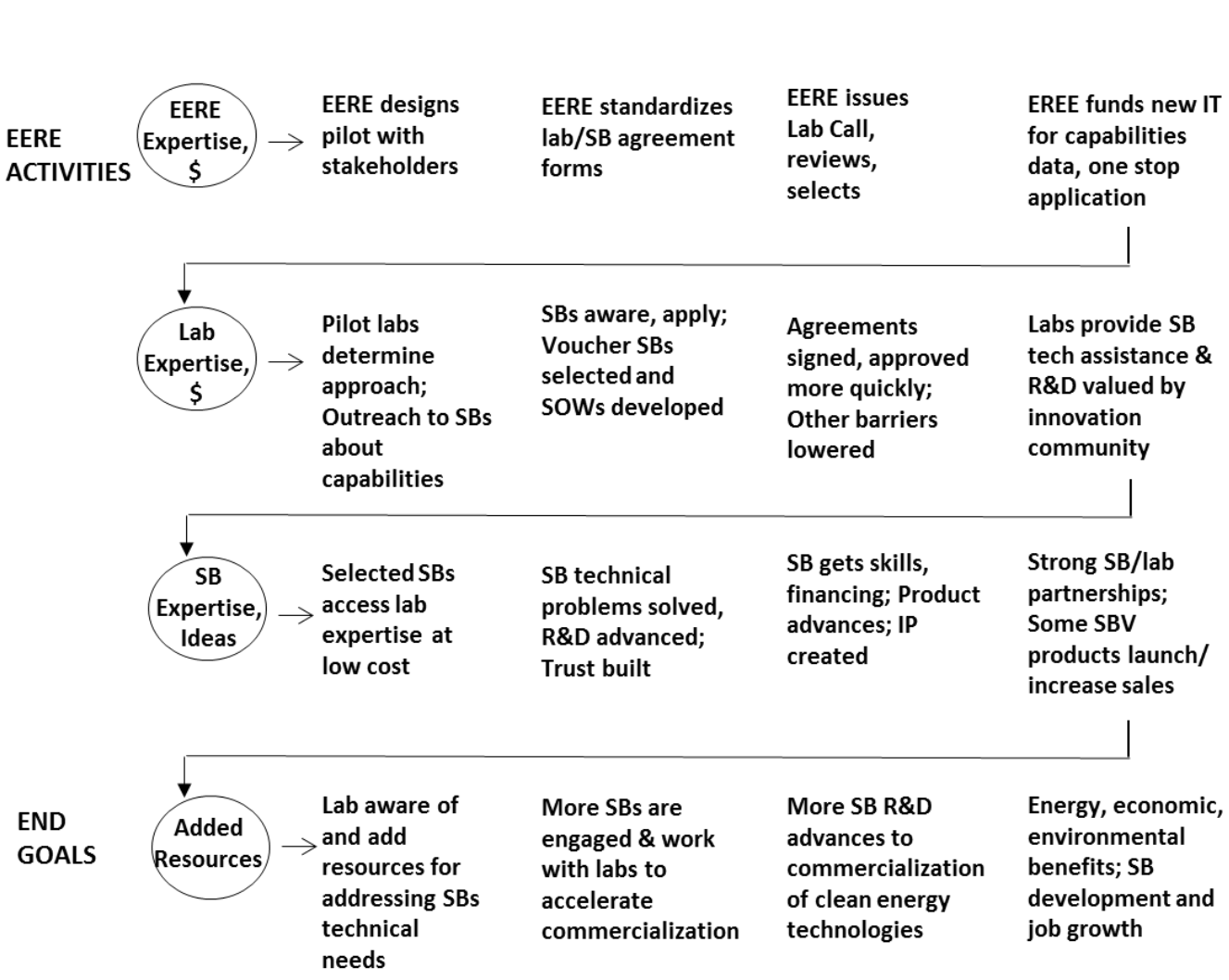
[28] This description is pertinent to the initiation of Round One only. The final Round One voucher selection process was driven by the Technology Offices, and the Technology Offices led the Round Two process.

- Labs negotiate signed agreements (contracts) with the small businesses, with DOE approval. Labs receive EERE funds to execute the project statements of work (funds cover lab staff and facility use). Each lab may take other actions to improve its interactions with small businesses.
- Labs provide technical assistance and cooperative research and development within the voucher program that is valued by the small businesses involved.

The response to EERE and lab actions and funding by the selected small businesses receiving vouchers are outcomes of those EERE and lab activities. The four groups of small business activities and expected outcomes one year after the start of the pilot (6 to 8 months after start of work on agreements) are:

- Small businesses with vouchers access the lab expertise and facilities, after working with lab staff to clarify a statement of work (SOW) and intellectual property matters where these apply. The businesses pay a minimum of 20 percent cost share, some of which may be in kind.
- Small businesses have technical problems solved, performance of prototypes validated, or make advances in research and product development, depending on their statements of work. In the process relationships and trust develop.
- Small businesses, depending on the SOW, continue to move toward commercialization. Commercialization progress could include making use of added skills, creating intellectual property, and/or securing additional financing for product development.
- More small businesses become more aware of lab capabilities
- Some of the small businesses refine existing products or commercialize new clean energy products, processes or practices, and sell these to consumers. Some may continue to work with the labs if they consider their lab partnerships to be strong and valuable.

Figure 2-1: Small Business Voucher Pilot's High Level Logic



Internal Sources of Variation:
Laboratories
Non-SBV small business support (CRADAs, tech assistance, related programs)
Technology area strengths
Proximity to relevant markets
Technology Offices
SBV processes
SBs/Projects
Initial stage of the technology,
Past experience in commercialization,
Market potential
Amount of financial support available;
Type of assistance received

External Sources of Variation:
Progress, characteristics of competing technologies
Market needs, opportunities
Government policies and incentives
Economics (price of electricity, etc.)
Social, cultural norms

2.6 INTERNAL AND EXTERNAL INFLUENCES ON PILOT SUCCESS

There are influences both internal and external to the SBV pilot that may drive or constrain success of the pilot and individual small businesses who are voucher recipients. The success of new product development is highly dependent on the characteristics of the developers (the voucher firms and the technical problems they sought to address), the product or innovation, and its current state of technology readiness. New product adoption is highly dependent on the characteristics of competing and complementary products as well as on broad economy-wide conditions and trends. The uncertain nature of new product development and adoption make it particularly difficult to come to clear conclusions in these evaluations.

To a lesser extent, pilot success might be affected by differing approaches used by the Technology Offices and participating labs, although the pilot as implemented has less variation across participating labs than suggested by the SBV Lab Call (see Section 4). Nonetheless, the labs deploy during the pilot differing internal processes. Most notably, the labs may differ in how they work with the small business to craft the project SOW, how they match principal investigators to the projects, how rapidly they commence and execute the work, how they conduct voucher-project oversight, and the quality of relationships they establish with small businesses during the course of the project.

The *SBV Technical Evaluation Plan* based its discussion of factors influencing pilot success on the description of lab activities given in the SBV Lab Call. The discussion in the *Evaluation Plan* built on conclusions of the Institute for Defense Analyses (IDA) 2011 technology transfer report, which identified variations among labs that affected commercialization outcomes, including lab mission and management.[29] We anticipate these lab differences exert minimal influence on pilot implementation and voucher project technical success. We will explore in annual surveys with participating small businesses whether participant satisfaction varies by lab and, if so, to what lab characteristics we might attribute the variation.

To recap, pilot success might be influenced by variation among the Technology Offices' approaches to SBV pilot participation and the participating labs internal processes, the characteristics of participating small businesses, and the technology involved, including:

- Initial stage of the technology, from idea to minor adjustment in an existing product to R&D on a possible new product
- Prior experience with commercialization

[29] *Technology Transfer and the Commercialization Landscape for Federal Laboratories*. 2011 IDA study. Appendix D summarizes the different lab characteristics that influence technology transfer.

- Market potential (size of potential demand, extent to which market delivery infrastructure exists, etc.)
- Amount of financial support available

External to the program are influences which primarily affect the two ends of the program logic, that is, the inputs and end outcomes. These include:

- Political visibility
- DOE business infrastructure
- Market needs/ opportunities
- R&D and deployment progress outside EERE, Labs
- Competing and supporting technologies
- Government policies and incentives
- Economics, including energy prices, price of what the new product would replace, availability of skilled labor, etc.
- Social/cultural norms such as consumer preferences, time horizon, etc.

Section 3 Early Outcome Metric Findings

This section provides outcomes of the pilot from launch through the award of Round Two vouchers. As described in Section 2.5, the program logic indicates EERE anticipates both early and later outcomes. The metrics provide program accomplishments through the award of Round Two contracts.

Table 3-1 gives the early outcome metric findings and the corresponding report sections that provides detail. The early outcomes are organized into three topics:

- Engagement of small businesses,
- Lab awareness of small business technical needs, and
- Lab commercialization assistance.

Table 3-1: Early Outcome Metrics Through Award of Round Two Vouchers (as of November 2016)

Outcome Area	Metric	Early Findings	Report Section
Engagement of small businesses	Increased lab outreach to small business	Each lab activated its own network and expanded its network based on ideas of other labs. Small businesses in 46 states and the District of Columbia submitted RFAs, 55% of which had not previously worked with a lab.	Sections 4.3.1, 4.4.3, and 5.3
	Number of registered CAP users	1,748 registered users	Section 5.1
	Number of RFAs submitted	893 RFAs	Section 5.1
	Number of vouchers awarded	77 vouchers	Section 5.6
	Amount of voucher funding awarded	$14.7 million	Section 5.6
	Number of technical assistance agreements signed	About one-third of vouchers*	Section 5.6
	Number of cooperative research and development agreements signed	About two-thirds of vouchers*	Section 5.6

Outcome Area	Metric	Early Findings	Report Section
	Shortened time to match principal investigator to project request	Occurs during voucher selection process; SBV process typically shorter than for other CRADA requests; time comparable to labs' own small business technical assistance.	Section 4.3.3
	Shortened time to develop statement of work (SOW)	Development of initial SOW occurs during voucher selection process; this shortens the process. Even so, Technology Offices ask for multiple iterations. Interviewed lab and EERE staff stated time is considerably shorter than pre-pilot, but remains longer than they would like. Pilot shifted to two rounds per year, to accommodate timeline.	Section 4.3.3
	Shortened time for DOE and lab staff to complete agreement execution approval processes (once statement of work completed)	Round Two contracts were executed within three months. Interviewed lab and EERE staff stated time is considerably shorter than pre-pilot, but remains longer than they would like. Delays due to such issues as transferring money from EERE to labs and continued revision to the statement of work.	Section 4.4.4
	Satisfactoriness of standard contracts to small businesses and labs	All awarded vouchers have been executed using the standard contracts, although in a few cases, Site Offices and lab contracting officers have raised objections to the contracts.	Section 4.4.3
	Lab satisfaction with engagement processes	Labs have high satisfaction with small business engagement.	Sections 4.3.3 and 6.1

Outcome Area	Metric	Early Findings	Report Section
Lab awareness of small business technical needs	Number of labs reviewing meritorious RFAs	All labs participating in a technology area review the top quartile of scored RFAs for that area, as part of the process that matches the most appropriate lab to the requested assistance.	Section 4.4.4
	Number of meritorious RFAs reviewed	Between one-quarter and one-half of all RFAs were judged meritorious by expert reviewers.	Sections 1.1 and 4.4.4
Lab commercialization assistance	Number of labs applying for lead lab role	Nine labs	Section 4.2
	Number of labs selected as lead labs	Five labs	Section 4.2
	Number of labs offering voucher assistance by technology area	Fourteen labs	Section 4.2
	Number of labs providing voucher assistance by technology area	Twelve labs	Section 4.2

* The SBV database provided to the evaluation team lacked this information for 27 of the 77 vouchers

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Section 4 SBV Pilot Activities Through Rounds One and Two Voucher Awards

This section presents findings from SBV's first two rounds of RFA open calls, including interviews with lead lab pilot manager teams, the SBV pilot manager, and three Technology Office managers; observation of two lead lab team meetings; and a review of program documents, as described in Section 2. The evaluation examines Rounds One and Two through the period of voucher award; it does not examine any activities undertaken in execution of the vouchers.

4.1 ROUND ONE AND TWO VOUCHER FUNDING BY TECHNOLOGY AREA

The pilot launched with about $20 million in funding and the intention to conduct up to three rounds of RFA open calls, contingent on funding remaining after the prior round. The pilot seeks funding for projects in nine areas it terms "technology areas." Table 4-1 lists these areas in the dark grey rows. They correspond with, but are different than, the EERE Technology Offices in the areas of energy efficiency, renewable energy, and sustainable transportation. (This report refers to "technology areas" when discussing the RFAs and awarded vouchers, as all RFAs and voucher awards pertain to a single technology area. The report refers to Technology Offices when describing the EERE organizations, including their staffs and budgets.). The Technology Offices designated topic areas for which they would award vouchers. The number of topic areas within each technology area ranged from a low of one topic area (for Advanced Manufacturing) to a high of seven topic areas (for Vehicles). Table 4-1 provides the publicized available voucher funding by technology and topic areas for which vouchers would be awarded. Pilot information clearly stated that funding for subsequent rounds was contingent on the amount of funding remaining after the prior round's awards. Thus, the two rounds of funding amounts shown in Table 4-1 are not additive. Round One founding represents total initial pilot funding (based on the FY2015 funding allocation) and Round Two represents initial pilot funding remaining after Round One. The open call for Round Two opened after the announcement of Round One awards and publicized the funding amounts listed in Table 4-1.[30]

[30] Funding amounts from *U.S. Department of Energy National Laboratory Network Notice of Opportunity: Small Business Vouchers (SBV) Request for Assistance (RFA)* – for Round One and Round Two.

Table 4-1: Round One and Two Voucher Funding Available by Technology and Topic Areas

Technology Area	Topic Area	Publicized Available Funding*	
		Round One	Round Two
Advanced Manufacturing		$4.4M	$3M
	Next generation materials		
Bioenergy		$2.1M	$1.5M
	Conversion technologies		
	Demonstration and market transformation		
	Analysis and sustainability		
	Algae		
	Feedstock logistics		
Buildings Technologies		$1.9M	$1.1M
	Energy consumption reduction		
	Demand side management and interoperability		
Fuel Cells Technologies		$2.9	$1.8M
	Fuel cells		
	Production and delivery		
	Storage		
	Safety codes and standards		
Geothermal Technologies		$1.4M	$1.1M
	Enhanced geothermal system		
	Low temperature geothermal		
	Systems analysis		

Technology Area	Topic Area	Publicized Available Funding*	
		Round One	Round Two
Solar Energy Technologies		$1.0M	$0.42M
	Balance of systems (BOS)		
	Concentrating solar power (CSP)		
	Systems integration (SI)		
	Photovoltaic (PV)		
Vehicle Technologies**		$2.4M	$1.26M
	Advanced combustion engines		
	Battery R&D		
	Electric drive R&D		
	Vehicle systems		
	Materials (lightweight)		
	Materials (propulsion)		
	Fuels and lubricants		
Water Power Technologies		$2.2M	$1.7M
	Marine and hydrokinetic power		
	Hydro power		
Wind Technologies		$1.0M	$0.66M
	Distributed wind		
	Utility scale wind		
Total* **		**$18.3M**	**$12.54M**

* Dollar amounts shown include funding for lab staff to administer the SBV Pilot. The Round One RFA provided exact dollar amounts (that is, seven-digit figures). The table lists Round One amounts in millions, for consistency with the Round Two RFA presentation in available funding.

** Both Rounds One and Two listed the funding available per topic area within Vehicle Technologies. The Vehicle Technology Office, and thus the request for RFAs for this technology area, had greater restrictions in its pilot funding than did the other Technology Offices.

***Total funding across technology areas is less than the $20 million figure used in pilot announcements because the total excludes funding for the CAP lab and the pilot evaluation.

4.2 PARTICIPATING LABS AND ROUNDS ONE AND TWO VOUCHER AWARDS

Nine labs, partnering with at least two non-submitting labs, submitted proposals in response to the SBV Lab Call for lead labs.[31] EERE selected five labs for award negotiations, and designated one lab as an alternate should "one or more of the selected labs not be amenable to the required changes to meet the Technology Offices' missions and strategic goals."[32] The lead labs, LBNL, NREL, ORNL, PNNL, and SNL, and the technology areas which EERE selected them to lead or co-lead, are shown in Table 4-2 with a bolded double check-mark (✓✓). Seven of the nine technology areas are led by two co-lead labs; the exceptions – solar energy and wind energy – are led by a single lab. Four of the five lead labs lead or co-lead three technology areas (the fifth, LBNL, co-leads four areas).

Nine labs in addition to the five lead labs participated in the first two rounds of the pilot, supporting the technology areas as illustrated in Table 4-2. The term "participate" indicates an ability to partner with a small business.[33] Two labs participate by supporting all nine technology areas, five labs participate by supporting one or two areas, and the remaining seven labs participate by supporting three to seven areas. From the small business perspective, they might partner with any of the ten or eleven labs in the areas of advanced manufacturing, fuel cells, and geothermal; four labs support solar energy work; and the remaining five technology areas are supported by six to eight labs.

[31] EERE provided the evaluation team with the selected proposals only. The selected labs proposed partnering both with other proposing labs and with two non-submitting labs (Lawrence Livermore and Los Alamos). We lack information on the partners proposed by the non-selected labs.

[32] *Selection Statement and Analysis, Small Business Vouchers Pilot Laboratory Call for Proposals, FY2015/16, Part 2: Selection Statement and Analysis.*

[33] The Technology Offices initially determined which labs could participate in the technology areas. A few labs were subsequently added by the Technology Offices in response to the services requested by small businesses.

Table 4-2: Participating Labs and the Technology Areas They Support*

	Adv. Mfg.	Bioenergy	Buildings	Fuel Cells	Geothermal	Solar	Vehicles	Water	Wind	Total
Ames	✓								✓	**2**
Argonne	✓	✓	✓	✓	✓		✓	✓	✓	**8**
Brookhaven				✓	✓					**2**
Fermi**	✓									**1**
Idaho	✓	✓			✓		✓	✓	✓	**5**
Lawrence Berkeley	✓✓	✓	✓	✓✓	✓✓		✓✓			**6**
Lawrence Livermore	✓				✓	✓			✓	**4**
Los Alamos		✓		✓	✓					**3**
National Energy Technology Laboratory (NETL)**					✓					**1**
NREL	✓	✓✓	✓	✓✓	✓	✓	✓	✓✓	✓	**9**
Oak Ridge	✓✓	✓	✓✓	✓	✓		✓✓	✓		**7**
Pacific Northwest		✓✓	✓✓	✓	✓	✓		✓✓	✓	**7**
Sandia	✓	✓	✓	✓	✓✓	✓✓	✓	✓	✓✓	**9**
Savannah River	✓			✓						**2**
Number of Labs	**10**	**8**	**6**	**10**	**10**	**4**	**6**	**6**	**7**	

* Bold typeface, as well as the double check mark, signifies lead (or co-lead) lab supporting a technology area.

** Selected as a partnering lab for Round Two voucher, although it was not listed on sbv.org at the time the round opened.

Through Rounds One and Two, the pilot awarded 77 vouchers totaling $14.7M (Round One: 33 vouchers, $6.7M; Round Two: 44 vouchers, $8M).[34] The pilot awarded vouchers in all nine technology areas to small businesses to partner with 12 of the 14 participating labs (Table 4-3). Numbers of vouchers awarded by participating lab ranged from highs of 16 and 17 vouchers awarded to ORNL and NREL respectively, to lows of 3 – awarded to PNNL and Lawrence Livermore, 2 – awarded to Idaho, and 1 – awarded to Fermi and Savannah River. Ames and Brookhaven did not receive any Round One or Two voucher awards. Consistent with the amount of pilot funding by technology area, numbers of awarded vouchers per technology area ranged from highs of 14 and 17 – awarded to Advanced Manufacturing and Fuel Cells, respectively, to lows of 3 and 4, awarded to wind energy and solar energy, respectively.

[34] Rounds One and Two did not expend all available pilot funding. Initial pilot funding (FY2015 funds) provided about $20 million for the pilot, inclusive of voucher awards, lead lab pilot administration, CAP development, and pilot evaluation. Voucher funding for subsequent rounds is contingent on funds remaining after prior round's voucher awards. EERE conducted a third round of SBV open calls and voucher awards, which it funded with the remainder of the initial FY2015 pilot funding, augmented with FY2017 pilot funding. The FY2017 funding also supports a fourth round.

Table 4-3: Participating Labs and Number of Round One and Two SBV Voucher Projects, by Technology Area

	Adv. Mfg.	Bioenergy	Buildings	Fuel Cells	Geothermal	Solar	Vehicles	Water	Wind	Total
Ames	-	-	-	-	-	-	-	-	-	**0**
Argonne	1	1	-	-	-	-	6	-	-	**8**
Brookhaven	-	-	-	-	-	-	-	-	-	**0**
Fermi	1	-	-	-	-	-	-	-	-	**1**
Idaho	2	-	-	-	-	-	-	-	-	**2**
Lawrence Berkeley	1*	4**	2	1	1*	-	3	-	-	**12**
Lawrence Livermore	2	-	-	-	1	-	-	-	-	**3**
Los Alamos	-	-	-	7**	-	-	-	-	-	**7**
NETL	-	-	-	-	1*	-	-	-	-	**1**
NREL	-	3**	2	8*	1	1	1	3*	-	**19**
Oak Ridge	6*	-	2	2*	2	-	3		-	**15**
Pacific Northwest	-	1	1	-	-	-	-	2	-	**4**
Sandia	1	1	-	1	1	3	-	2*	3	**12**
Savannah River	1	-	-	-	-	-	-	-	-	**1**
Multi-Lab Projects	1	3	0	2	1	0	0	1	0	**8**
Unique Projects	14	7	7	17	6	4	13	6	3	**77**

* One multi-lab project.

** Two multi-lab projects.

SBV awarded the following multi-lab vouchers:

- Advanced Manufacturing – ORNL/LBNL (Round Two)
- Bioenergy – NREL/LBNL, NREL/PNNL (Round One), LBNL/SNL (Round Two)
- Fuel Cells – LANL/NREL, ORNL/LANL (Round One)
- Geothermal – LBNL/NETL (Round Two)
- Water Power – NREL/SNL (Round One)

4.3 PRIMARY PILOT COMPONENTS AS IMPLEMENTED

The basic description of the pilot – to fund small business access to lab expertise and facilities to solve critical technology problems through merit-reviewed requests for assistance, and to provide the funded services – is deceptively simple. In practice, the pilot in its first year has proven to be complex, largely due to its crosscutting nature (nine Technology Offices, five lead labs, another nine non-lead labs) and to EERE funding constraints. The primary pilot components are best understood from four perspectives – the components apparent to small businesses, the activities undertaken by the lead labs (as articulated in the SBV Lab Call and as implemented by the labs), the activities conducted by the Technology Offices, and the activities of the EERE SBV pilot manager.

4.3.1 Pilot Components Experienced by Small Business

As evident to small businesses, the primary pilot components are:

- Multiple **announcements** of the pilot opportunity (outreach)
- **Website** – sbv.org – one location for all pilot-related information, such as:
    - Detailed information about each lab's specialization relating to the technology area, providing the opportunity for any small business anywhere to partner with any participating lab
    - Access to a CAP portal for submitting RFAs
    - Detailed information about pilot eligibility and application requirements, RFA review criteria, and pilot processes and timeline
    - Standard, short agreements for pilot cooperative research and development (SBV CRADA) and technology assistance (SBV TAPA, for technology assistance pilot agreement) that govern all voucher projects
    - Frequently asked questions (FAQs)
    - Showcase of awarded/active projects by technology area
- **Point of contact service** – contact information (both phone and email) for lead lab staff available to answer pilot questions by technology area, and for staff at all participating labs available to answer lab-specific questions by technology area
- **Merit review**, match with most appropriate lab and lab staff, and **selection** of awardees
- **Statement of work** development and signed agreements
- **Receipt of vouchers** to fund the research
- **Execution** of the research in partnership with the labs

The pilot designed each of these small-business-facing components to reduce known barriers to small business-lab partnerships, as described in narrative form in Section 1.2.

- Lack of awareness that the labs partner with small businesses,
- Lack of awareness of the expertise and facilities/equipment that the labs offer in the arenas of energy efficiency, renewable energy, and sustainable transportation
- Lack of knowledge of which labs offer what expertise,
- Lack of confidence a lab would be receptive to a request for assistance, and lack of information on who to contact at a lab to explore whether the lab might be able to assist with a technical challenge the business faces,
- Lack of confidence that one's request might be paired by the lab with an appropriate researcher, or that the researcher will prioritize one's project and meet project deadlines,
- Lack of funds to contract with labs,
- Lack of knowledge about how to contract with labs (what the contracting vehicles are and who to contact about contracting) and, if have this knowledge, limited resources to negotiate the project-specific CRADAs and technical assistance agreements required when applying outside of established small-business programs,[35] and
- Need to make rapid progress with technical development and not be postponed with long periods for labs to make decisions about requests or to negotiate contracts.

4.3.2 Lead Lab Pilot Components, as Itemized in the SBV Lab Call

The SBV Lab Call requires the lead labs to conduct the following seven activities, which constitutes another statement of primary pilot components:

1. **Outreach** – create and implement an outreach strategy
2. **Partnerships** – form partnerships to help the pilot have the broadest possible impact, such as with technology incubators/accelerators, regional, state, and local organizations, economic development organizations, trade associations, and investor networks

[35] Small business programs include the New Mexico Small Business Assistance program supported by Los Alamos and Sandia National Laboratories, INL's and PNNL's Technical Assistance Programs, and NREL's Commercialization Assistance Program.

3. **Unique capabilities** – identify, engage, and deploy the best available and appropriate resources (staff and facilities) to offer both technology assistance and collaborative R&D
4. **Voucher application evaluation** – identify qualified internal (lab staff) and external reviewers to ensure the highest quality merit review of RFAs
5. **Business practices** – create and maintain a process to match and manage the internal resources providing the best fit for the needs of the small businesses
6. **Collaboration** – comprises three subcomponents:
    a. **CAP deployment** – collaborate with the CAP-development lab, including involvement in developing and implementing the application, merit review, and selection process, and preparing informational and outreach materials for the pilot web landing page (sbv.org).
    b. **Consistent implementation** – collaborate with all lead and non-lead labs with the goal that the small business pilot experience will be consistent across all labs.
    c. **Providing technical assistance or collaborative R&D** – collaborate with non-lead labs to ensure small businesses have access to the most appropriate resources.[36]
7. **Reporting** – track, manage, and report progress of work performed under SBV agreements and provide information to the third-party evaluator

4.3.3 Lead Lab Pilot Components, as Conducted by Lead Labs

The lead lab activities during the first year of the pilot suggest a somewhat different articulation of primary pilot components than evident from the SBV Lab Call:

- **Pilot design** – The lead labs contributed pilot design ideas and feedback to the EERE pilot manager.
- **Communications, outreach and outreach partnerships** – The lead labs formed a communications and outreach committee consisting of representatives from all lead labs, with non-lead labs invited to attend. The committee developed a strategy, reviewed and approved language for promotional materials, identified types of outreach partners, and contacted potential partners. Each lead lab has its own network of organizations it engages with to

[36] Requirement developed by SBV pilot team in response to concern expressed by DOE's General Council that all RFAs be judged equitably on their merits, regardless of the fit between the technical assistance required and the lead lab capabilities. Source: March 9, 2015 interview with Joyce Yang, Director, Lab Impact Initiative.

further its mission; the lead labs both activated those networks on behalf of SBV and learned from each other possibilities for expanding their networks.

Two lead labs had key communications roles and generated materials reviewed by the committee. One lab, working with a strategic communications contractor developed most of the website content. Another lab took responsibility for outreach language, material development, and press release drafts. Participating labs and EERE issued most press releases.

The communications committee produced or reviewed all pilot communications, including:

- language to announce the opening of the portal for applications,
- messaging to applicants to inform them of their selection status,
- responses to questions posed by visitors to the site (which were then posted as FAQs),
- webinar to describe to small businesses and other interested audiences the pilot and its processes, and
- outreach materials for small businesses and labs to use in describing their partnerships to avoid any implication that either DOE or the labs are endorsing specific companies or products.

- **Central application platform (CAP) and website** – The CAP lab took responsibility for the website development, including programming the innovation management software to receive, archive, provide, screen, and score (merit review) the RFAs, and track the RFA scores. Another lead lab led the development of the site framework, design, and content describing the pilot. The CAP lab then executed the design and content into the framework outline. All participating labs contributed lab-specific descriptions and visuals, conforming to a design aesthetic developed by the one of the lead labs.[37]

  The CAP lab was also charged with such responsibilities as:

  - testing the CAP prior to launch,
  - maintaining the platform to assure functionality,
  - conveying current information as key dates and timeline, available funding, RFA requirements, and pilot processes change by round,
  - providing access to RFAs to lead labs, reviewers, and Technology Offices,
  - reporting on site usage and submitted RFAs,

[37] This subtask of developing lab-specific descriptions, as with many of the subtasks, was itself a complex, multi-step process. The lab leading this activity designed, through multiple iterations internally, among the lead labs, and with EERE, a template for labs to use to showcase their capabilities. The labs provided content to the leading lab who then iterated with the lab to fill in any gaps, had all lab descriptions rewritten by a technical editor so they had a single narrative "voice," and obtained approval from each lab for the final copy.

  - assuring the security of applicants' data, and
  - conducting Google analytics to investigate site usage.

- **Point of contact service** – Adopting an idea one of the lead labs included in its pilot proposal to EERE, the lead labs created a point of contact (POC) service, dedicating specific staff to respond to pilot questions by technology area. All participating labs identified staff available to answer lab-specific questions by technology area. Small businesses could reach the POC staff by email or phone and the staff endeavored to make reply contact with the small business within 24 hours, although some questions could not be answered immediately, such as questions touching on SBV policy that needed to be answered by EERE. The POC staff "curated" the questions to contribute to the FAQ.
- **Pilot administration** – The lead labs formed a steering committee (as specified in the SBV Lab Call) to provide oversight for all pilot activities, including such things as:

  - promoting consistency across labs,
  - developing timelines,
  - addressing the multiple lead lab implementation structure and the associated division of labor,[38]
  - developing financial processes by which vouchers would be funded at non-lead labs (see next bullet),
  - coordinating with the Technology Offices, and
  - determining the desirability and logistics of splitting a given voucher between two labs, and so on.

- **Budgeting and billing** – As part of pilot administration, the lead labs manage the budgeting and billing processes. Each lead lab negotiated with EERE an administrative cost calculated as a percent of the pilot money for each technology area the lab leads; labs co-leading technology areas split the pilot funding for those areas and calculate their administrative cost as a percent of their share. Some Technology Offices distributed their voucher monies directly to the voucher performing labs, and distributed administrative monies to lead labs. Other Technology Offices awarded all their pilot funding to their lead labs, who then faced the task of distributing voucher monies to voucher performing labs. The lead labs needing to distribute voucher monies to other labs did so

[38] EERE negotiated with each lead lab a budget consistent with the total pilot funding cap and reflecting the funding caps for each technology area the lab would support. The labs varied in their expectations of administrative time required and in the type and amount of cost-share they offered EERE, if any. Further, the actual administrative requirements of the pilot were unknown at the time of the SBV Lab Call as the labs' pilot responsibilities included taking the pilot from concept stage (the Lab Call) to full implementation. Consequently, the labs attempted to have a division of labor roughly in line with the administrative budget of each.

either through a type of subcontracting arrangement with the voucher performing labs or through arrangements made by the Technology Offices. Finally, all participating labs receive pilot funds at the topic level within each technology area according to the Budget and Reporting (B&R) classification codes.[39]

- **Merit review process** – The lead labs formed a merit review committee to guide the development of the open call, the merit review criteria, the review process, and the composition of the review teams for each technology area. The CAP lab drafted the open call and the merit review criteria. In Round One, the lead labs for each technology area identified a stable of reviewers (lead and non-lead lab staff and external experts) for that area. In Round Two, the Technology Offices identified and selected the merit reviewers (all external to the labs). The merit review committee developed and delivered a webinar to guide reviewers in applying the review criteria.

  The website described the merit review criteria and process. The CAP lab programmed the innovation management software to accommodate the eligibility screening and merit review.

- **Merit review implementation** – In Round One, the pilot teams at each lead lab managed the merit reviews of RFAs in their technology areas, coordinating with the other labs also serving the technology area. In Round Two, one lead lab managed the implementation of the merit review. The lead labs led/co-led the process of matching each RFA to the lab best suited to partner in the research (referred to as the lab-match process). The lead labs also led/co-led the semi-finalist and finalist selection processes. Overall management entailed:

  - assigning RFAs to appropriate reviewers,
  - identifying and engaging additional reviewers as needed to appropriately review all RFAs received,
  - guiding reviewers,
  - providing deadlines, and
  - managing work to the deadline.

  The semi-finalist selection, and finalist selection processes entailed:

  - coordinating and leading calls with the Technology Office and participating labs for the technology area,

[39] Table 4-1 identifies the Round One and Two funding available by technology area, and lists the topic areas for which each Technology Office had allocated voucher funding. Each topic area has a corresponding B&R code. The number of topic areas for each Technology Office ranged from a low of one topic area (Advanced Manufacturing) to a high of seven topic areas (Vehicles).

  - overseeing the budget, policy, and conflict of interest factors related to selections by Technology Offices, and
  - presenting to the Technology Offices on, and managing the selection of, the semi-finalists and finalists.

- **Conflict of interest (COI)** – The lead labs formed a conflict of interest working group to establish and deploy processes that would minimize the likelihood of a conflict of interest on the part of any lab, lab researcher, or merit reviewer. The working group grappled with whether and how to restrict lab staff communication with small businesses about the pilot given that businesses with a prior or ongoing relationship with a lab were equally welcome to participate in the pilot as businesses without such relationships. The working group developed COI guidance for staff in pilot roles such as the lab POC, merit reviewers, and potential SBV project principle investigators. Guidance included acceptable interactions with small businesses and forbidden interactions, including writing any part of the RFA (including the SOW), reviewing the RFA in its entirety and suggesting improvements, or submitting an RFA on behalf of a small business.
- **Awarding vouchers, creating statements of work, and conducting voucher work** – In processes that changed from pilot conception through Round Two,[40] in Round Two the lead labs worked closely with the Technology Offices, with non-lead labs, and with meritorious small businesses during the phase of awarding vouchers and creating statements of work. After completion of the merit reviews, the lead labs coordinated a phone meeting with all the labs offering services in the given technology area and discussed the top 25% of RFAs and decided which lab can best offer the requested services, which may or may not be the lab requested by the small business.[41]

  The labs matched to the RFAs assigned a principal investigator (PI) who had the skills and availability to provide the requested services and the PI developed a one-slide for presentation to the Technology Office outlining the work scope.[42] The scope included the activities that would be funded through the voucher and how the goals of the request for assistance would be met. The lab also contacted the small business, explained that it had passed the first review cycle, and requested that it prepare one-slide to accompany the lab-prepared slide in

[40] Processes continued to evolve with Rounds Three and Four. This section describes Round Two processes.

[41] Small businesses have the option of requesting to work with specific labs. Many do not make this request.

[42] The lab-matching meeting might conclude that two labs would be equally suited to partner with the small business, in which case both labs assign a PI to prepare a one-slide work scope for the Technology Office.

the presentation to the Technology Office describing the firm, the need for the requested assistance, and the potential for high project impact.

After the Technology Office selected the semi-finalists from among the top 25% of RFAs for which it received presentations (termed "summary reviews"), the PIs and labs worked with those small businesses on the statement of work, budget, and schedule, iterating with the Technology Office as needed. When the Technology Office approved the award, the statements of work and standard contracts (SBV CRADAs and SBV TAPAs) are execution by the voucher performing lab contingent on the approval of the lab's Site Office.[43]

The voucher performing labs partnered with the small business to conduct the SOW.[44] The labs managed these projects with the same protocols, tracking and reporting they use to manage all their research. The SBV Lab Call specified that the labs would provide mid-term reporting for SBV projects greater than $150,000 or six months' duration, as well as reporting SBV project status generally.

- **Data collection and reporting** – To be responsive to the pilot goal that it be evaluable and provide the data necessary to support possible expansion throughout DOE, data reporting in Round One was provided by three lead labs. The process was formalized in Round Two, with a single lead lab assuming responsibility. The data tracking function includes maintaining RFA and merit review data, obtaining voucher-related data from voucher performing labs, and identifying data needed from small businesses. The data reporting function includes keeping the lead labs and EERE SBV pilot manager informed, reporting to DOE managers, and providing information to the evaluation team.
- **Inter-organizational coordination** – The lead labs engaged in extensive pilot coordination with the other lead labs to implement the pilot, with the non-lead labs offering services in their technology areas, with the voucher performing labs (both lead and non-lead) in their technology areas, with the EERE SBV pilot manager, and with the Technology Offices.

[43] Site Offices are organizations within the U.S. Department of Energy's Office of Science with responsibility to oversee and manage the Management and Operating (M&O) contractor for the national lab. See www.science.energy.gov/about/field-operations. DOE's Office of Science oversees 10 labs; other DOE offices similarly manage M&O contractors for the labs under their purview. Contracts for all SBV voucher awards must be approved by the performing lab's Site Office.

[44] As of November 2016, SBV projects were underway; none had completed.

4.3.4 Pilot Components as Conducted by EERE Technology Offices

From the perspective of Technology Offices, the pilot activities entailed:

- **Pilot design** – contributed pilot design ideas and feedback as EERE sought stakeholder input.
- **Standard contracts** – contributed as a stakeholder to the development of standard pilot contracts (SBV CRADAs and SBV TAPAs);[45] agreed to fund work using the standard contracts.
- **Budgets and topic areas** – allocated voucher budgets at levels specified by EERE management. Identified topic areas for which they would award vouchers.
- **Lead lab selection** – conducted technical review of lab SBV proposals and selected five lead labs.[46]
- **Pilot roll-out** – met with lead lab pilot manager teams during the initial lab pilot planning meeting (August 4-5, 2015) to discuss budgets and billing and other pilot issues. Staff at a few Technology Offices played key roles through-out the early pilot roll-out.
- **Voucher awards, statements of work** – reviewed RFA merit review scores and rankings, considered the relative merits of the top ranked 25%, selected semi-finalist applicants, iterated as necessary on statements of work, made final selection of awardees, and approved statements of work.
- **Disbursement of pilot funds** – authorized the payment of funds to labs.
- **Coordination with labs** – worked with the labs to convey their research needs, their sense of the market, their assessment of the potential for high impact projects among the meritorious RFAs, their thinking in develop statements of work, and so on.
- **Coordination with the EERE SBV pilot manager** – worked with the SBV pilot manager to adapt pilot processes to meet Technology Office needs.

[45] EERE worked with DOE General Council to develop the SBV CRADA and SBV TAPA, having as starting points the Short-Form CRADA and PNNL's Technical Assistance Program agreement and receiving stakeholder comments. As part of the development process, EERE worked with the lab-situated Site Offices to reach agreement that the SBV CRADA and SBV TAPA would govern all SBV awards. All parties to SBV vouchers agree to the terms and conditions with no amendments.

[46] Reviewers were technical mangers in each Technology Office nominated by the director to comprise the SBV Tiger Team. Labs selected based on its essential capabilities to deliver to small businesses.

4.3.5 Pilot Components as Conducted by the EERE SBV Pilot Manager

The EERE SBV pilot manager actively directed the pilot and was involved in all facets. Thus, the SBV pilot manager was involved in the planning, execution, or review and approval of every component described for the lead labs and Technology Offices. In addition, the SBV pilot manager represented the pilot within the National Laboratory Impact Initiative team and within EERE more broadly.

4.3.6 Component Implementation Compared with Pilot's Initial Logic

The logic model (presented in Section 2, Figure 2-1) describes the program's logic as evidenced by the SBV Lab Call. As described throughout this chapter, the pilot has evolved significantly at every stage, starting with the EERE's selection of co-lead labs through the award of Round Two vouchers. However, this evolution has affected the *implementation* of the key pilot activities as identified in the logic model, and not the activities themselves nor their intended outcomes. While it is true that differing implementation approaches would potentially have different measured outcomes (such as number of applicants, speed of contracting, and so on), the ongoing changes in implementation did not affect the *types* of intended outcomes, which are illustrated in the logic model and remain the pilot's intended outcomes. Thus, while the path between activity and outcome has changed from that described by the SBV Lab Call, the pilot's basic activities and outcomes remain the same.

4.4 PILOT EVOLUTION

Consistent with its pilot status, SBV has evolved since the SBV Lab Call. The evolution is best understood by the changes occurring between four periods that we articulated based on program activities as described in program documents and by interviewed lab and EERE staff:[47]

1. **SBV Lab Call, Lab Proposals, and Selection of Lead Labs** – EERE's development of the SBV Lab Call for lead labs (issued on March 23, 2015), development of lab proposals (April 26 submission), and EERE negotiation of scope and budget with lead labs (between the May 22 Merit Review Advisory Report and EERE's July 8 announcement of lead labs),
2. **Pilot Development, Round One Launch, Round One Merit Review** – Lead lab activity to develop the pilot (initiated by EERE and the lead labs with a meeting August 4-5), the launch Round One (September 23), and completion of lab-led merit reviews of Round One RFAs (December 15, 2015),

[47] We note that neither the lead labs nor EERE spoke of evolutionary "periods" for SBV. We developed this structure to facilitate presentation of our findings.

3. **Round One Voucher Awards** – EERE activity, supported by the lead labs, to select Round One meritorious vouchers, develop statements of work, and award vouchers (December 15 to the March 10, 2016 awards announcement), and
4. **Round Two** – Lead lab activity, supported by EERE, to revise pilot processes for Round Two (January 10, 2016), culminating in the Round Two voucher awards (August 18).

Pilot processes continued to evolve in the next period – activity leading up to Round Three awards; this evaluation covers only activity through Round Two awards, exclusive of any voucher implementation associated with the rounds.

4.4.1 SBV Lab Call, Lab Proposals, and Selection of Lead Labs

The SBV Lab Call requested that proposing labs describe how they would conduct the seven pilot components described in Section □.[48] One of these seven components was collaboration with the other lead labs and with non-lead labs to provide small businesses with consistent pilot experiences as they work with any lab on any technology area. Even so, labs proposing to serve as lead labs necessarily had to describe how they would conduct the pilot. The proposing labs elaborated on the seven requested components to convey a vision, supported by design and implementation details, that they thought would be most effective.

For example, one lab subsequently selected as a lead lab proposed "guiding each small business through the entire SBV Pilot process, starting with recommending ways to strengthen their assistance requests, then helping them connect with DOE technologies and appropriate DOE laboratories, and finally, guiding them through the assistance and commercialization stages" by linking them to incubation and financing networks.[49] Two of the labs subsequently selected as lead labs branded their SBV approach with a name. As one of these labs described, in phrasing that could describe any of the selected proposals, "The [branded name] program will incorporate a number of critical and differentiated innovations and capabilities to make it an invaluable pilot partner for DOE and the other national labs." Thus, in developing what they hoped were compelling, winning proposals, the proposing labs sketched pilot visions and details that made each proposal unique.

The labs also addressed how they would meet the "partnership" component of the pilot as described in the SBV Lab Call. One of the labs subsequently selected as a lead lab described how it would partner with the entire national laboratory system engaged in research in the identified technology areas, as well as partnering with six named non-

[48] Outreach; partnerships; unique capabilities; voucher application evaluation; business practices; collaboration; and reporting.

[49] From the proposal of a lead lab. Proposal is not in the public domain.

lab clean energy technology entities across the nation. “Our national partnership approach will link federal, non-profit, lab, and private sector stakeholders to create an SBV Pilot ‘network of networks.’” The other lead labs proposed specific lab partners. SNL proposed partnering with Los Alamos and Lawrence Livermore; LBNL proposed partnering with Lawrence Livermore and SNL/California; and NREL and ORNL both proposed partnerships of NREL, ORNL, and Argonne National Laboratory (ANL). ORNL augmented its partnership structure by including three additional labs as providing technical expertise and one additional lab as providing outreach.

Thus, the SBV Lab Call and the subsequent proposals contained a tension between the development by lead labs of unique programs deploying unique partnerships and the recognition by all parties that lead labs would need to collaborate with all labs (all leads and participating non-leads) and that the pilot would offer a consistent experience to all small businesses.

Indeed, until the lead up to the pilot public launch in September 2015, the tension was weighted toward the centrality of the lead labs in pilot implementation and voucher work. In the words of the SBV pilot manager interviewed at that time, vouchers with non-lead labs were expected to be “one-offs.” The increasing role of the non-lead labs became apparent in the weeks before the launch as Technology Offices requested that the capabilities of additional labs be added to the pilot website.

The SBV Lab Call also contained a tension between the pilot roles of EERE and the labs. The SBV Lab Call stated that EERE was allowing the labs engaged in the pilot “greater flexibility” than in existing technology assistance programs in place at the labs “to create new business practice innovations for the best results.”[50] The EERE SBV pilot manager from pilot launch through Round One restated this intention in interviews with the evaluation team, and lab pilot managers described their assumptions that they would be designing and implementing the pilot.

EERE received proposals from nine labs to serve as a lead lab for the pilot. It conducted an independent merit review of proposals received. The reviewers issued on May 22 a Merit Review Advisory Report selecting five labs and one alternate lab.

This initial pilot period culminated with EERE’s scope of work and budget negotiations with the selected lead labs and their agreement to serve.[51] At this point, the labs understood that EERE was designating two labs as co-leads for seven of the nine technology areas. Selected labs were now partnering with their co-leads, rather than with their proposed partners. Only one of the seven co-lead assignments approximated the proposed partnership: for geothermal, LBNL was co-leading with SNL, after

[50] *Small Business Vouchers Pilot Laboratory Call for Proposals,* March 23, 2015. Page 3.

[51] All selected labs signed agreements. EERE did not contract with the alternate lab.

partnered in the proposal with SNL/California. SNL was also selected as the single lead for two technology areas, and its proposed partners (Los Alamos and Lawrence Livermore) did not have an explicit role. To be clear, the labs understood that their proposed networks would still be essential to pilot success.

4.4.2 Pilot Development, Round One Launch, Round One Merit Review

The SBV Lab Call specified the timeline for pilot development and launch:

> *Within 30 days of the start of the pilot, the selected SBV Pilot Laboratories will collaboratively reach agreement on the contents of the online SBV application form and a standardized evaluation and selection plan and process […]. The voucher evaluation and selection plan will be reviewed and concurred upon by DOE. The SBV Pilot Laboratories will work with the EERE and the CAP administrator to deploy the process and the Central Application Platform publicly.*

By the August 4-5 SBV initiation meeting, EERE had extended the timeline by two weeks. The lead labs met the goal and the pilot began accepting applications seven weeks after the kick-off meeting (September 23, 2015).

The lead lab pilot project teams gathered in early August to begin development of a single program across all technology areas that garnered the approval of the five lead labs as well as EERE (and, by implication, the Technology Offices). Program development included:

- Specifying all pilot processes, including but not limited to:
  - Application requirements, including RFA content, RFA format, and information to provide in conjunction with the RFA
  - Timeline (for applicants, for internal process execution)
  - Assignment of RFAs to labs for review
  - Merit review, including scoring system, review process, and reviewer selection and training
  - Conflict of interest management
  - Support to be provided to potential applicants
- Developing the CAP to receive, archive, retrieve, screen, and score RFAs
- Working with Technology Offices to understand needs, budgets, billing, and lab payments
  - Incorporating all labs working in the EERE arena,
  - Designing the website architecture and content templates,
  - Developing and approving all content posted on the website,
  - Conducting outreach, including developing processes and content and executing outreach, and

- Developing a deploying a POC service, which included ensuring the consistency of responses and messaging used by the POC staff working with small businesses.

The lead labs working in collaboration – that is, in committees - in seven weeks designed and publicly launched a complex program.[52] As the lead labs undertook this work, numerous questions arose that required EERE directive. Some of these questions became apparent to the labs as they sought to specify pilot design and implementation details. Other questions that required EERE direction were posed by the small businesses that accessed the site or spoke with POC staff. Thus, EERE, as well as the labs, mobilized to launch the pilot in seven weeks.

During pilot development, the labs drew on the innovative ideas they proposed in response to the SBV Lab Call. Proposal features that most directly translated into pilot approaches include the POC service and the partners, networks, and venues the labs would use to promote the pilot. The lead labs were also served by the ideas they had developed for merit review, for establishing a pool of reviewers, and for addressing conflict of interest. However, these latter ideas provided only starting points for lab process development, as the proposal ideas differed among the labs.

The merit review committee developed the merit review criteria and the review process used in Round One. The Round One merit review awarded:

- Up to 50 points to “technical merit & lab alignment,” comprising:
  - a clear problem statement (10 points),
  - innovation benefits (as defined by cost savings, increased performance, new products, and five other possible benefits; 20 points), and
  - alignment with lab capabilities (20 points).
- Up to 40 points to “business and market impact,” seeking high impact as indicated by:
  - quality of firm’s plan to use the SBV assistance to advance their business, industry, or marketplace (15 points),
  - extent to which innovation will contribute to the clean energy marketplace or advance technology development (15 points), and
  - feasibility of innovation deployment plan (10 points).

[52] Because committees are comprised of individuals, each with their own ideas, strengths, and weaknesses, conducting work through a committee structure is universally recognized as slower than conducting work through a structure that has a single authority.

- Up to 10 points for “qualifications and experience,” defined as:
    - Extent to which team can execute a successful product and subsequent deployment

The CAP site provided small businesses with the merit review criteria. Round One began accepting RFAs on September 23, with a submission deadline of October 23.

The lead labs for each technology area identified a stable of reviewers (lead and non-lead lab staff and external experts) for that area and the merit review committee delivered training to the reviewers. The lead labs then managed the reviewers and provided direction consonant with ideas of the merit review committee. The reviewers scored each RFA in each subcriterion (above) on a five-point score (“5” high) and also recorded in narrative form their thinking that led to the scores assigned.

After the reviewers scored each RFA in the technology area, the lead labs for that area held a call with all reviewers to go over the scores assigned and the rationale. Through this dialogue, the lead labs sought to increase the interrater reliability, dampening any systematic effects resulting from differences in what raters assumed would warrant a perfect score and in the amount of points they subtracted for deviation from the hypothetical perfect presentation. These calls concluded with final scores for each RFA, a ranked set of RFAs within each technology area, and cut-off rank above which the lead labs recommended the Technology Office use to award vouchers.

Consistent with the SBV Lab Call and all pilot planning up to this time, the lead labs prepared to recommend to the Technology Offices which RFAs should be awarded voucher funding.

4.4.3 Round One Voucher Awards

The lead labs developed slideshows for each Technology Office presenting the RFA scores and ranking, with brief descriptions of the assistance requested, and recommended that the offices award vouchers to the highest ranked RFAs, (e.g., those above the cut-off rank). This process – that of the lead labs recommending to the Technology Offices – was consistent with the process described in the SBV Lab Call and discussed by the lead labs and SBV pilot manager during the August 2015 kick-off meeting.

The Technology Offices varied in their responses to the presentations, but overall the offices requested more information than the labs initially presented. The Technology Offices requested more detail on two topics: (1) what lab activities the assistance would entail (a summary-draft of the SOW) and (2) RFAs below the cut-off rank that nonetheless were scored as meritorious. The lead labs and Technology Offices iterated to develop a roughly complete description of the work associated with each meritorious RFA. The engagement of the Technology Offices in this process of considering the

meritorious RFAs varied, with some providing considerable guidance and others taking "a more hands off" approach.

Because Technology Offices are constrained by Congressional budgets that specify funding by B&R code, the Technology Offices sought to fund the most meritorious RFAs consistent with their mandates, their technology road maps, and their funding constraints. Within B&R costs, some Technology Offices further allocate their funding into different focus areas. In some cases, the Technology Office manager was aware of similar work the office was already funding. Further complicating the voucher awards process, the Technology Offices differed in how they disbursed their office's pilot funding (FY2015), some having initially sent it directly to labs serving as leads for their area and others holding the money to distribute it to the labs at the time of voucher execution. All of these factors led the Technology Offices to direct or be closely involved in the selection of small businesses to award with vouchers.

The Round One posted timeline stated that small businesses would be notified of the selections in mid-December (about two months after the round closed), with finalization of project SOW, budget, and cost share occurring between mid-December to February, when voucher work was anticipated to begin. The lead labs offered their award recommendations to the Technology Offices and began the process of voucher selection in mid-December. On March 10, 2016, EERE announced the Round One voucher awards, four and a half months after the close of the open call. Over three-quarters of Round One contracts were finalized by the end of March 2016, three months after the first negotiations began; the remaining seven contracts were finalized by mid-August.

4.4.4 Round Two

Round Two differed from Round One in multiple respects, the most salient of which are:

- the specification of a shorter RFA,
- a simplified merit review scoring schema,
- a single lead lab designated to implement the merit review process,
- exclusive use of external, paid reviewers,
- presentation of RFA review summaries to the Technical Office on the 25% top-ranked RFAs, and
- development of the project statements of work.

The Round Two open call "streamlined" the RFA specifications, limiting the RFA to four pages, including tables and graphics, down from Round One's limit of five pages, exclusive of two pages of tables and graphics included as documentation. The Round Two call did not ask small businesses to specify the dollar value of the requested voucher as the lead labs had concluded, based on the Round One submittals, that

businesses lacked information on which to base an estimate of the staff and facility costs necessitated by their research.

The lead labs also simplified the Round Two scoring criteria. Reviewers used a three-point scale (equivalent to a "thumbs up," "thumbs down," and intermediate score) and assigned points in each of three areas, each weighted equally:

- Potential for impact – comprising:
  - alignment with the technology area's mission,
  - innovativeness, and
  - market impact, including how the assistance will advance the small business's technology and how the technology will advance the market.
- Problem definition – comprising:
  - problem identification, and
  - quality and reasonableness.
- Team and resources – comprising:
  - capabilities, and
  - resources.

Also in Round Two, EERE designated a single lead lab to implement the merit review process. The merit review lab (termed herein the MR lab) identified potential external reviewers from among the reviewers already used by the Technology Offices, as well as reviewers identified by the labs. The MR lab recruited the reviewers, trained them, assigned them RFAs to review appropriate to their expertise, answered their questions, and managed the review process to completion.[53] The MR lab developed a final score for each RFA by averaging, for each reviewer, the three subcomponent scores (impact, problem, team) and then averaging the resulting scores across the reviewers.

The lead labs had observed considerable variability in the Round One merit review scores among reviewers and among technology areas. The Technology Offices expressed a concern that lab staff were among the experts on the Round One review teams, making them vulnerable to accusations of self-dealing by rating highly RFAs for work suited to their labs. Although no such bias was identified, EERE made the decision that the Round Two reviews would be conducted solely by external, paid reviewers.[54] Contributing to the decision to go with external reviewers, several Technology Office

[53] The MR lab developed a Round Two pool of about 120 potential reviewers and assigned RFAs to about 95 of those.

[54] EERE provided a nominal payment of $100 per review cycle. Round One reviewees received no compensation.

managers were concerned that they did not know the lab reviewers, whereas they were already working with external reviewers in support of their research agendas.

Round Two also differed from Round One in the process of voucher selection. In Round One, the lead labs had understood their role as recommending to the Technology Offices RFAs to be awarded vouchers. In Round Two, the lead labs presented to the Technology Offices the top quartile of ranked RFAs.

After RFA scoring, the lead labs conducted a lab-match call with all labs participating in the technology area, as well as with Technology Office representatives. The call generated consensus on which lab – or in few cases, labs – were best suited to provide the requested assistance. As described in detail in Section 4.3.3, the labs prepare a review summary of each RFA, consisting of a one-slide draft SOW to provide the requested assistance, coupled with a slide prepared by the small business. The labs then presented the top quartile of ranked RFAs to the Technology Offices. The Technology Offices then selected semi-finalists and for those submittals, the labs prepared statements of work, budgets, and cost-shares, on which the Technology Offices based its final voucher selection. EERE announced the Round Two voucher awards on August 18, a little over four months after the round closed. Round Two contracts were signed by November, three months after the negotiation of the first contract started.

Section 5 Characterization of Round One and Two Requests for Assistance and Awards

This section provides an analysis of Round One and Two small business Requests for Assistance and voucher awards.[55] Applicants were required to provide basic information about themselves (such as contact information) and answer a few questions, in addition to uploading a narrative request for assistance. Rounds One and Two requested somewhat different information from applicants, and thus some of the data presented in this section are available for only a single round.

5.1 INTEREST IN THE SBV PILOT

Interest in the SBV pilot can be gauged by the numbers of small businesses registering at sbv.org and submitting RFAs.[56] The pilot launched publicly with the opening of Round One on September 23, 2015. By the time the round closed a month later, 902 people had created accounts (Table 5-1). From then until the opening of Round Two on March 10, 2016, another 377 people registered. By the end of Round Two a month later, an additional 469 people registered. In total, 1,748 people registered at the CAP by the end of Round Two. Small businesses submitted 459 RFAs in Round One and 390 RFAs in Round Two, for a total of 849 RFAs.

Table 5-1: Registered CAP Users and RFAs Submitted, by Round

Time Frame	Registered Users	RFAs Submitted
As of the close of Round One (October 23, 2015)	902	459
As of the close of Round Two (April 10, 2015)	846	390
Total	**1,748**	**849**

5.2 REQUESTS FOR ASSISTANCE BY TECHNOLOGY AREA

As described in Section 1, voucher funding available per technology area varied from a maximum of about $4.4 million for Advanced Manufacturing to a minimum of about $1

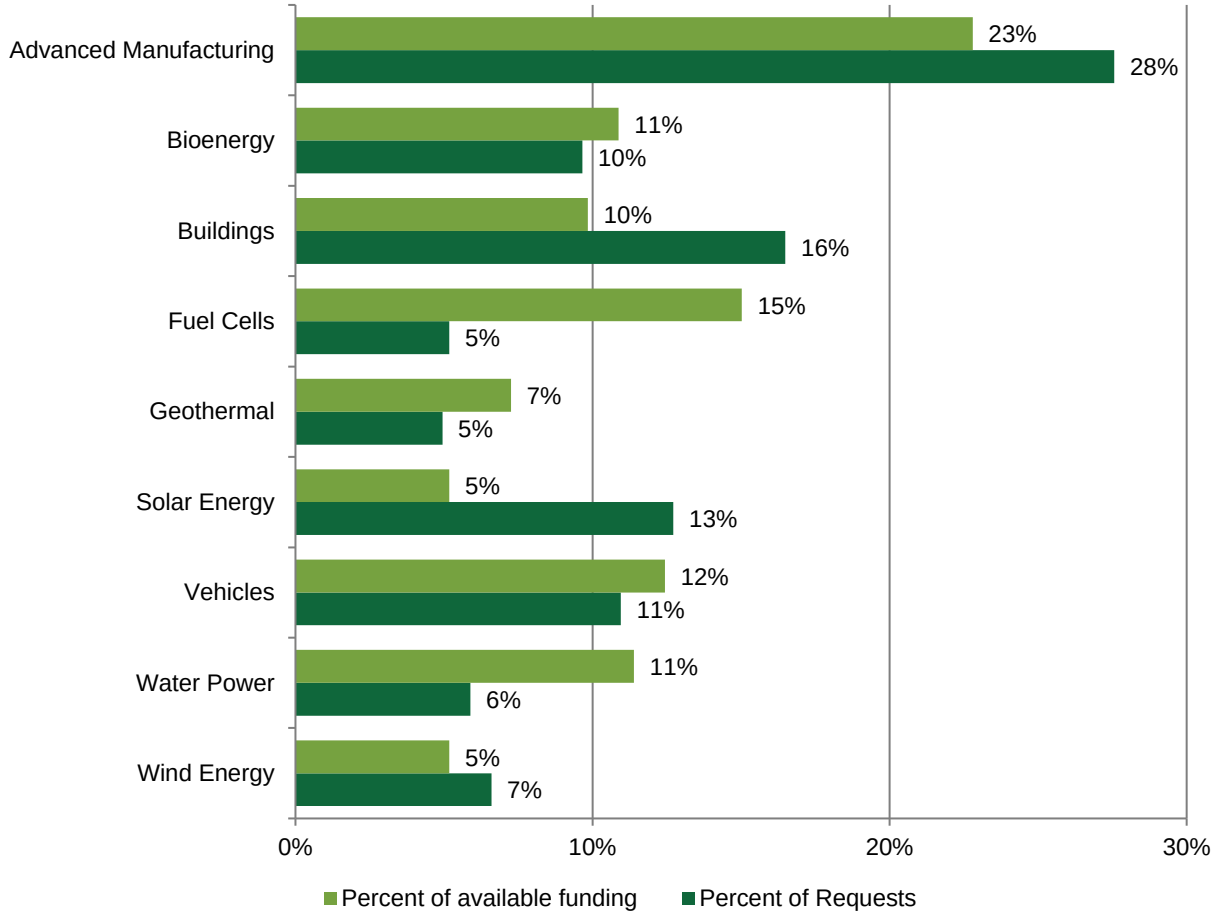
[55] The section analyzes data provided by LBNL from the Round One and Two CAP data captured and reported by the IdeaScale software.

[56] To submit an RFA, small businesses needed to first register with the CAP.

million each for Solar Power and Wind Power. Consistent with this funding allocation, Advanced Manufacturing received the highest proportion of RFAs (

Figure 5-1). This funding level and small business response for Advanced Manufacturing is consistent with the broad nature of the technologies in that area. As explained by the Technology Office manager, innovations in the other technology areas that concern the manufacture of those technologies (such as the manufacture of efficient building materials) could potentially fit equally well both with Advanced Manufacturing and with the other technology area (in this example, Buildings). Although the website informed small businesses of the funds available by technology area, there was more competition for funds in some areas than others. For example, Fuel Cells offered 15% of the pilot funding yet received 5% of the RFAs; Solar Energy was in the opposite position, offering 5% of the pilot funding and receiving 13% of the requests. As consequence of the relative supply of and demand for voucher funds, Fuel Cells funded relatively more of the requests it received (it funded 17 vouchers), while Solar Energy funded relatively fewer (4 vouchers).

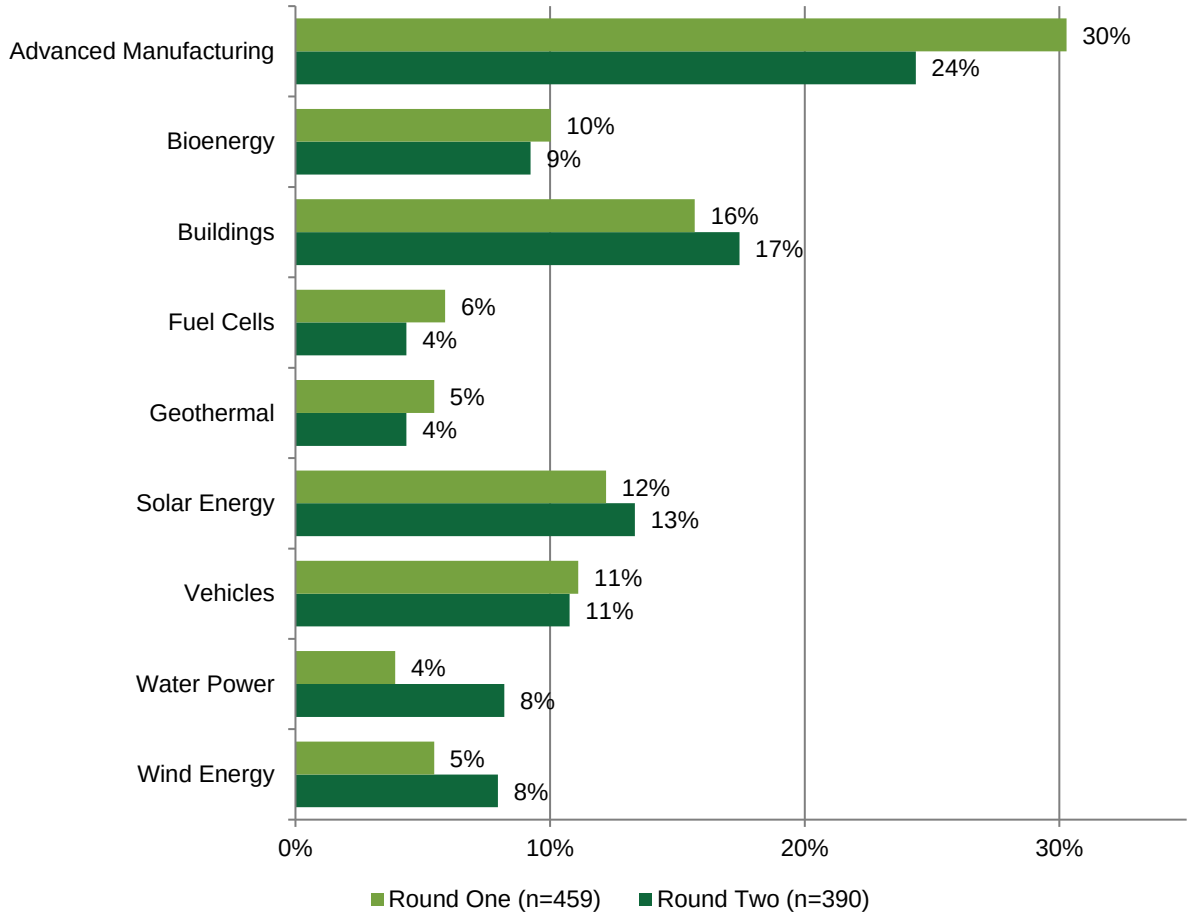
Figure 5-1: Requests for Assistance and Available Funding by Technology Area (Rounds One and Two Total, n=849)



Overall, requests for assistance funding far outstripped the available supply; the pilot awarded vouchers to about 9% of small businesses submitting RFAs.

Round One and Two requests by technology area were similar, with Advanced Manufacturing showing the greatest between-round differences (a six percentage-point decrease in proportion of RFAs from Round One to Round Two; Figure 5-2). Water Power showed the most gains from Round One to Round Two, of four percentage points.

Figure 5-2: Percent of RFAs by Technology Area, by Round (n= 849)

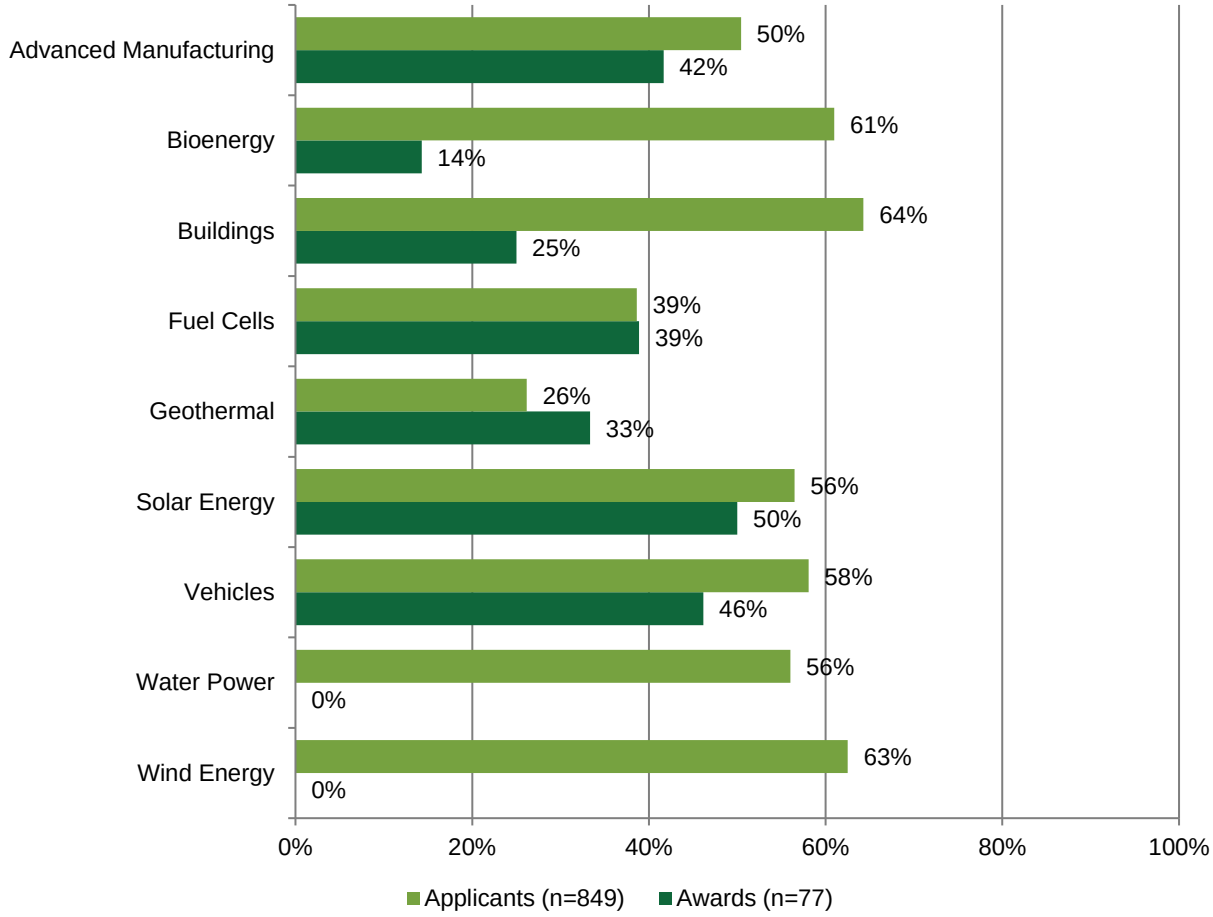


5.3 APPLICANT CHARACTERISTICS

The pilot seeks to expand relationships between small businesses and the labs, including serving small businesses that had not previously worked with the labs. Fifty-five percent of RFAs came from small businesses that had not previously worked with a lab; among awardees, 32% had not previously worked with a lab.

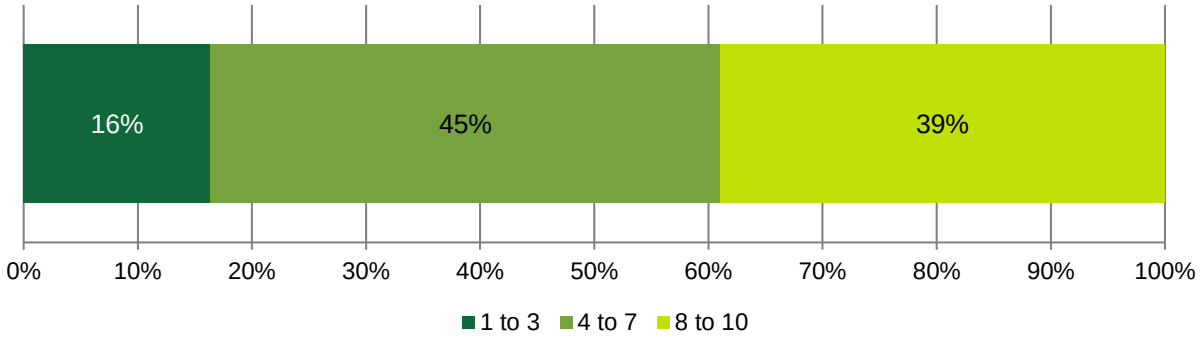
Geothermal was unique among the technology areas in awarding projects to small business that were less likely to have previously worked with a lab than were those in the larger set of businesses that submitted RFAs (33% versus 26%; Figure 5-3). At the other end of the spectrum, all awardees in the areas of Water Power and Wind Energy had previously worked with a lab.

Figure 5-3: Percent of Applicants and Awardees that Had Not Previously Worked with a National Lab (n=849)



Round Two applicants (but not Round One) were asked in their application to rate their awareness of DOE lab capabilities and facilities using a ten-point scale, where "1" indicated no awareness and "10" indicated a great deal of awareness. Thirty-nine percent of applicants rated their awareness as generally high, which we define as ratings of "8", "9" and "10" (Figure 5-4). About one-sixth of applicants rated their awareness as low ("1," "2" and "3"). Applicants' average self-ratings were similar across technology areas.

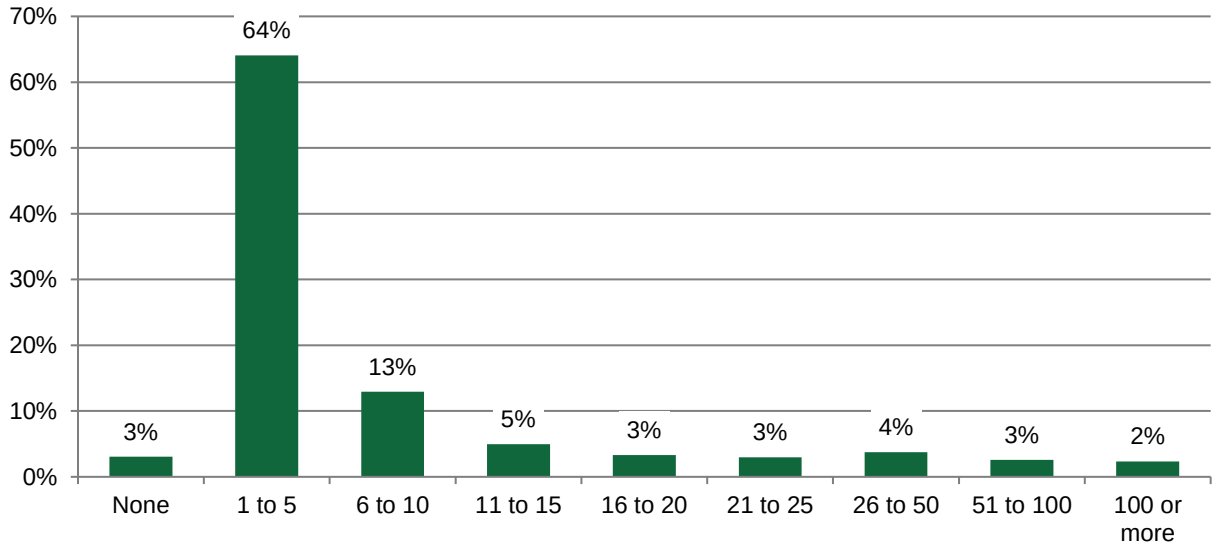
Figure 5-4: Awareness Rating of Lab Capabilities and Facilities (Round Two, n=390, "1" is low, "10" is high)*



*Question was asked only of Round Two applicants.

Round One and Two applicants each averaged about 12 employees (Round One average was 13 employees, and Round Two average was 11). However, the average firm size is relative to the maximum size; the pilot accepts firms with up to 499 employees. The distribution of number of employees clearly shows that SBV is attracting very small firms – including would-be startups that currently have no employees – that are working on critical technical challenges. Two-thirds of applicants have fewer than six employees (Figure 5-5).

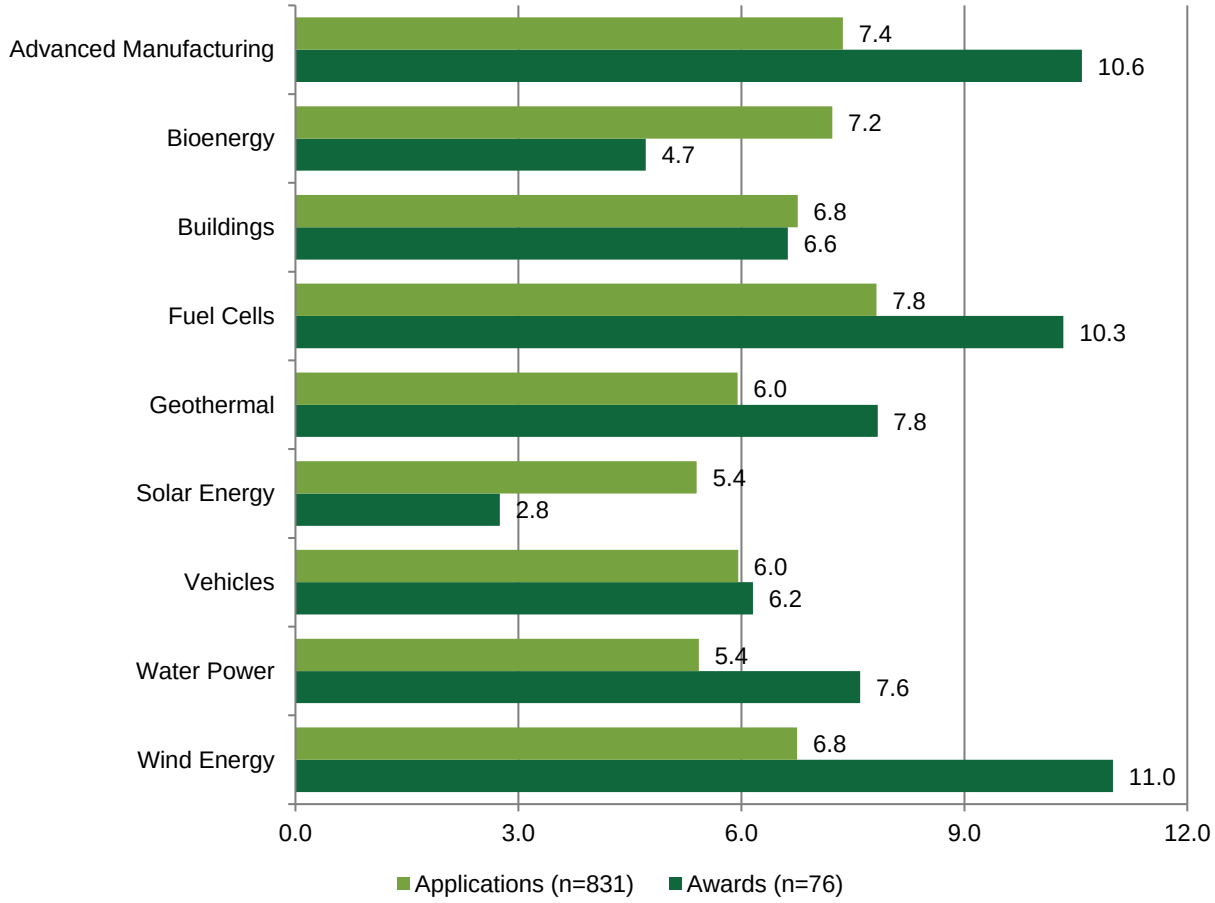
Figure 5-5: Number of FTE Employees (Rounds One and Two Total, n=823)*



* Missing employee information for 26 cases

Small business applicants had been in business an average of 6.7 years; voucher recipients had been in business an average of 8.0 years. Small businesses receiving Bioenergy and Solar Energy vouchers were unusual among the technology areas in averaging fewer years in business than did their larger sets of applicants (Figure 5-6).

Figure 5-6: Average Years in Business (Rounds One and Two Total, n=831)*



* Missing information for 18 cases.

Applicants came from 46 states and the District of Columbia (as well as one non-qualifying applicant from outside the U.S.; Table 5-2.) Voucher awardees came from 25 states.

Table 5-2: Location of Small Businesses Submitting RFAs and Receiving Voucher Awards (Rounds One and Two Total, n=849, 77)

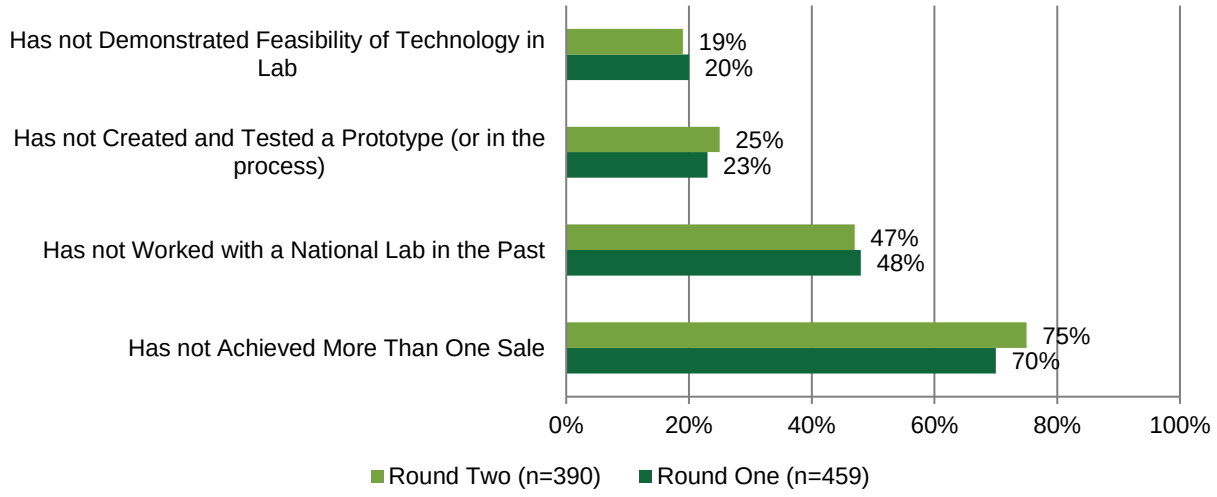
State	RFA	Voucher		State	RFA	Voucher		State	RFA	Voucher
AK	5	0		LA	2	0		OK	0	0
AL	2	0		MA	42	5		OR	20	4
AR	2	0		MD	12	0		PA	34	2
AZ	13	1		ME	4	1		RI	2	0
CA	184	22		MI	35	4		SC	2	0
CO	54	1		MN	16	0		SD	1	0
CT	15	2		MO	9	2		TN	23	1
DC	1	0		MS	6	0		TX	29	4
DE	10	1		MT	5	0		UT	6	0
FL	38	2		NC	9	1		VA	19	3
GA	7	1		ND	0	0		VT	6	0
HI	3	0		NE	0	0		WA	42	4
IA	7	0		NH	3	0		WI	12	2
ID	12	0		NJ	17	2		WV	0	0
IL	21	2		NM	36	3		WY	1	0
IN	5	0		NV	4	1				
KS	1	0		NY	45	3		Not in U.S.	1	0
KY	5	0		OH	21	3		**Total**	**849**	**77**

5.4 TECHNOLOGY DEVELOPMENT CHARACTERISTICS

The stage of technology development among vouchers awarded resembled that of the larger pool of requests for assistance. About three-quarters of both groups requested assistance for technologies that had not reached the market and garnered sales (Figure 5-7). About half of the technologies of both groups had yet to be demonstrated as meeting the needs of the intended application. About one-quarter of the technologies of both groups had not reached the stages of having a tested prototype or having demonstrated feasibility in a lab setting. These stages of technology development across the RFAs and voucher awards are consistent with pilot objectives that vouchers

would be used for such activities as intermediate scaling to generate samples for potential customers, validation of technology performance, and prototyping.

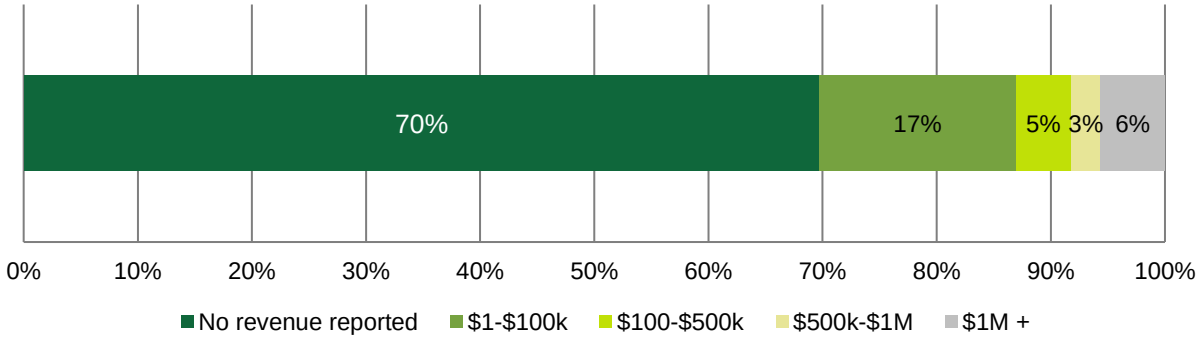
Figure 5-7: Technology Development Characteristics by Applicants and Awards (n=849)



One-third (35%) of Round Two applicants (Round One applicants did not report this information) had received no private investment.

Looking at revenue from a product associated with SBV, 70% of Round Two applicants reported no revenue; 17% had received amounts less than $100,000; 5% had received $100,000 to $500,000; 3% had received $500,000 to $1,000,000; and 6% had received more than $1,000,000 (Figure 5-8).

Figure 5-8: Current Revenue from Product Associated with SBV (Round Two, n=390)



5.5 COMPLIANCE AND MERIT REVIEW OUTCOMES

Nearly all applications (over 98%) satisfied the pilot's eligibility requirements and entered the merit review process. The merit review awarded points on three principal factors: potential for impact, problem definition, and team resources. The weights of the three factors changed from Round One to Round Two, as did the articulation of the factors, although at a conceptual level, the factors were stable across the rounds (see Sections 4.4.3 and 4.4.4). Given the changes from Round One to Round Two, we present in this section an analysis of Round Two merit review scores.

We were interested in the degree to which applicants' awareness of the labs' capabilities was associated with their merit review scores. A correlation analysis of the self-reported awareness rating and the review score of all Round Two RFAs produced a correlation of 0.42, suggesting that roughly 20% of the variation in review scores could be associated with variation in awareness of the labs. Thus, for the entire applicant population, greater awareness of the labs was mildly associated with higher merit scores; applicants with little awareness of the labs tended to have lower merit scores. This finding held across technical areas.

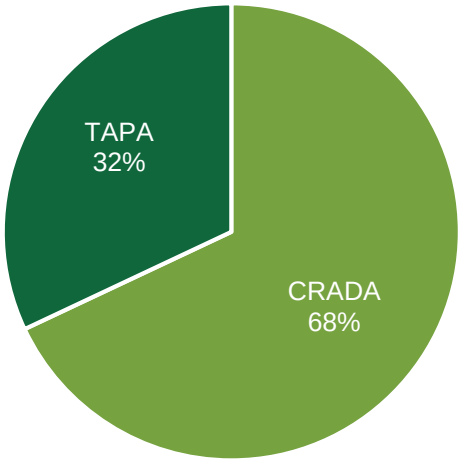
Of considerable interest, however, is the finding of little correlation among voucher *awardees* of awareness of labs and merit score (a correlation 0.13). This finding clearly indicates that meritorious ideas rose to the top, regardless of applicants' lab awareness. This finding supports an interpretation that the pilot is providing vouchers to meritorious small businesses that have not previously worked with the labs (32%, as reported in Section 5.3) and that a small business with a good idea does not need to know much about the labs to have its application be judged meritorious.

5.6 VOUCHER AWARDS

The pilot awarded 33 SBV vouchers in Round One (7.2% of 459 applicants) and 44 vouchers in Round Two (11.3% of 390 applicants), for a total of 77 vouchers (9.1% of 849 applicants). Round One awarded $6.7M in voucher funding and Round Two awarded $8M, for a total of $14.7M. About two-thirds of the vouchers resulted in SBV CRADAs and one-third resulted in SBV TAPAs (Figure 5-9).[57]

[57] The SBV database provided to the evaluation team lacked this information for 27 of the 77 vouchers.

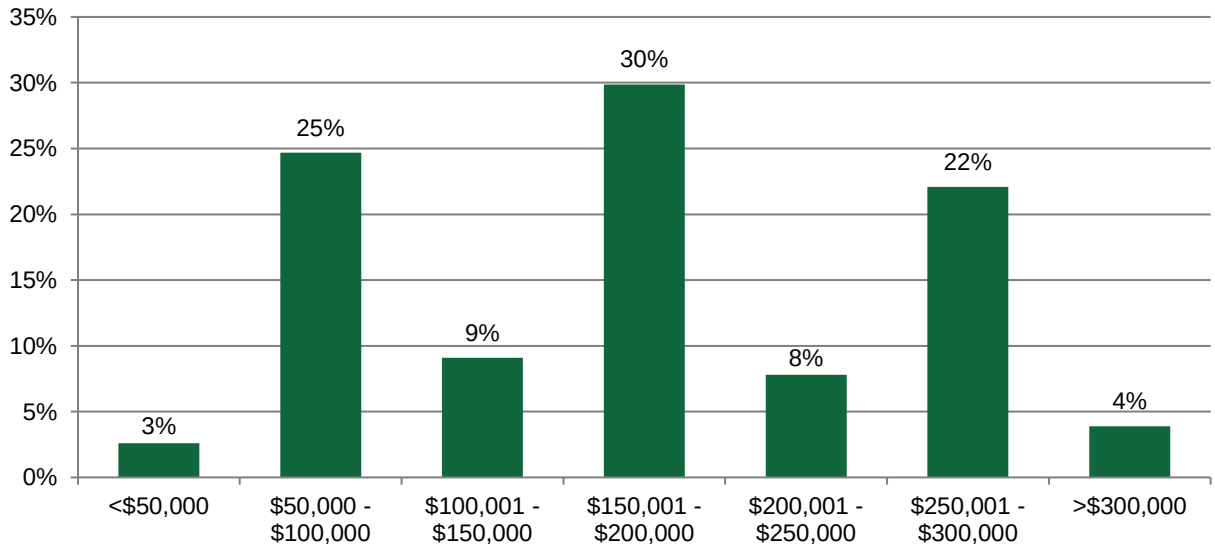
Figure 5-9: Contract Type (Rounds One and Two Total, n=50)*



* Missing contract information for 27 cases.

Voucher awards were most commonly in the ranges of $50,000 to $100,000, $150,000 to $200,000 and $250,000 to $300,000 (Figure 5-10). Although as publicized vouchers ranged from $50,000 to $300,000 in size, five of the 77 vouchers awarded fell outside that range, as determined by EERE based on the final SOW. The average voucher size was $191,386.

Figure 5-10: Award Amount (Rounds One and Two Total, n=77)



Section 6 Pilot Early Process Outcomes

This section discusses SBV's early process outcomes from the perspectives of the interviewed five lead lab pilot manager teams, EERE SBV pilot manager, and three Technology Office SBV managers. The first subsection highlights the benefits the pilot has reaped and the second subsection discusses remaining challenges as identified and described by the nine interviewees.

6.1 PILOT ON TRACK TO MEET ONE-YEAR GOALS

The interviewed lab pilot managers, EERE SBV pilot manager, and Technology Office managers described multiple benefits evident from the SBV pilot through the award of Round Two vouchers. Many of the described benefits suggest the pilot is meeting or progressing toward its goals, presented in Section 1.1. Interviewees also described some unanticipated benefits.

6.1.1 Pilot Benefits to Small Business

6.1.1.1 Small Businesses Gain Awareness of the Opportunity

First among its stated goals, the pilot aims to increase engagement between the labs and small businesses in the clean technology sector. As a precondition to increased engagement, small businesses need to be aware that engagement with the labs is possible. As reported in Section 1.2, the small business sector has little awareness that the labs partner with the private sector, of the types of resources the labs offer in aggregate, and of the specific research areas, expertise, and facilities each lab provides. The five lead labs engaged in extensive pilot outreach and the website's simple design clearly showcases the individual lab resources relevant to the technology areas targeted by the pilot. As reported by the EERE SBV pilot manager, the small businesses credited the SBV website with developing their understanding of the labs. More than half of small businesses requesting assistance had not previously worked with the lab.

All interviewees credited the pilot with increasing small business awareness of the possibility and suitability of engaging with the labs in cooperative research and development or technical assistance projects. All lead lab pilot managers described new outreach venues and activities. Labs that were already engaged in small business outreach in support of initiatives they conducted substantially expanded their contacts, noting that their prior outreach activities were scaled to generate demand for services commensurate with initiative funding. In some cases, the existing initiative was limited to small businesses located in the same state as the lab, which restricted these lab's prior outreach activities to their own state. For SBV, all lead labs expanded their existing networks to reach national audiences.

Lab pilot managers also noted that the SBV outreach and website "speaks about the labs' capabilities across the board," that is, as the DOE national laboratory system, rather than as an individual lab. This information makes SBV a unique mechanism for informing the public at large – businesses small and large, as well as interested individuals – about valuable technical resource the national lab system supplies to the US economy. In the words of one interviewed lab pilot manager:

> *What I really appreciate about SBV is that it is not about an individual lab, with an individual relationship with a business. It's a pooled activity among the labs. Small businesses get a national look, an opportunity to sift through all the labs, and to partner with labs they may not be familiar with.*

Because of this system-wide offering, labs that do not have a reputation for economic development activities (such as working with small businesses) or clean energy reach a wide audience with the message that they are able and willing. The list of participating labs has grown to 14 labs from the 5 labs selected in response to the SBV Lab Call.

SBV provides small businesses with both information about labs throughout the country and the opportunity to easily partner with labs that may be located thousands of miles away from them. As one lab pilot manager phrased it:

> *We have learned that there are firms all over the country, small and medium size, that are extremely interested in working with the labs to solve technical solutions. We have learned there's a lot we can do to engage with industry that does not require them to relocate near us. There's a big population that does not live near these centers of expertise. This is an opportunity for us. We can move knowledge and capabilities without moving people.*

By including lab-specific POC information, the pilot enables small businesses to develop a strong understanding of the capabilities of specific labs and what a partnership might offer them. According to one lab pilot manager:

> *We [all of the labs] are having more discussions in advance of the voucher describing our capabilities and what we can offer. Absent the voucher, these conversations would not happen.*

6.1.1.2 Small Business Gain Awareness of How to Proceed

In addition to lack of awareness of the opportunity for suitable engagement with the labs, small businesses face the barrier of not knowing who to contact at the lab for help in identifying possible partnering opportunities and processes for pursuing them. The website clearly identified who to contact (the POC information for each technology area for the pilot overall and by lab), and the pilot provided a simple process for pursuing partnering opportunities. Interviewed pilot POC managers were unanimous in their assessments that small businesses benefitted from and greatly appreciated the

individual support provided to them. POC managers from two lab pilot teams offered the following remarks:

> *Just having a person on the phone seemed to be an enormous benefit to the small business community. My phone rang off the hook for four weeks. And the email was incredible.*
>
> *The small businesses were so appreciative that someone answers the phone, calls them back. One firm said, "Really? That's all there is to the application?"*

Yet the pilot's success in communicating to small businesses how to proceed is simply the first step; the pilot structure is designed to make it as easy as possible for the small businesses, every step of the way. For example, the lab-match process identifies the most appropriate lab for the research needed. The review summary provides a preliminary list of tasks and becomes the starting point for the SOW. The labs assign a PI to the project; the PI works with the small business and the Technology Office to develop the final SOW. Small businesses know from the outset of their involvement the terms of the SBV CRADA and SBV TAPA agreements. Each step is clearly defined, timelines are set (although not always met), and the process moves toward contract execution without the small business needing to initiate these activities or track that its project has not gotten shunted to the side.

6.1.1.3 Small Businesses Gain Knowledge and Capabilities

Both lab pilot managers and Technology Office SBV managers characterized SBV as providing a mechanism – funded cooperative research and development and technical assistance – by which small businesses can gain knowledge and capability. SBV enables the small businesses to learn from the expertise provided by the lab – "knowledge transfer."

6.1.1.4 Small Businesses Gain Project Funding

All interviewed lab pilot managers emphasized that it is the voucher funding that has enabled the 77 CRADA and TAPA agreements with small businesses. Although the extensive outreach and the streamlined procedures and agreements are instrumental to the accomplishments of the pilot to date, without pilot funding, there would be no vouchers of the size awarded by SBV. Awareness and knowledge of labs do not alone generate partnerships; small businesses also need to have the funds to cover the costs of the lab services sought, which the pilot provided.

Although most of the lab pilot managers identified benefits resulting from the pilot that they fully anticipate will continue regardless of whether the voucher program continues (as described in Section 6.1.2), they recognize that few of the participating small businesses would be able to afford the lab's services in the absence of a voucher.

As illustrated in Figure 1-2 in Section 1.2, the pilot provides funding for larger projects than possible through the few non-SBV lab small business programs. This larger funding size is advantageous to both the small business and the lab. Small businesses can tackle larger challenges than otherwise with the greater support available through the pilot. The participating labs find it easier to interest their scientists in projects of this size range. As one lab pilot manager explained, scientists run a greater risk of budget overruns with projects smaller than SBV; the concept is akin to measurement error – there is more aggregate measurement error in the measurement of many small pieces than in the measurement of one larger one. And SBV projects are not so large that the labs have difficulty finding staff with sufficient availability to take on the projects. As one lab pilot manager said:

> *The PIs are liking this. For them, it's low-hanging fruit, a good opportunity. It's fun, it won't break their budgets. Because the vouchers awards tap into our unique expertise, the projects are in the PIs' wheelhouses.*

6.1.2 Pilot Benefits to Labs

6.1.2.1 Labs Gain Knowledge of Small Businesses

The interviewees described how the lab and EERE pilot managers "have strong desire to make this as easy as possible for small businesses." Through the pilot, all parties have developed a better understanding of how to provide small businesses with access – both funding and other support – to lab facilities and researchers.

All lead lab pilot managers spoke not only of conducting increased outreach, as described previously, but of "having a better understanding" of how to target and speak to the small business sector. With each round, the lead labs are increasing the numbers and types of networks they access, with the intention of bring in not just more small business, but also to increase the proportion of RFAs from small businesses that lack any prior connection to the labs. Most interviewees spontaneously noted that this increased understanding of communications will support their labs' commercialization activities beyond the pilot. Through the pilot, labs have gained awareness of companies working in related spheres of research.

6.1.2.2 Labs Gain New Research Perspectives

Two of the interviewed lab pilot managers spontaneously described that their increased understanding of small businesses has already begun to influence their research activities. Said a pilot manager at one lab:

> *On a couple of our Round One projects, there has been some very interesting work that has helped push the PIs into some different directions*

Speaking for a second lab, a pilot manager said:

> *It's helped our lab and our researchers better understand what the technological challenges are for certain sectors of work. We get that somewhat from reviewing the RFAs, but actually engaging with them [in the voucher selection process] helps us craft our [ongoing] research better, so it's more applicable to that sector and those challenges. … It's a bottom-up way to develop new research opportunities as a team.… And we have more knowledge about how to share outcomes with the people who might really be interested in that.*

6.1.2.3 Labs Gain New Non-pilot Partnerships

Several interviewed lab pilot managers reported that their participation in the pilot has led to new non-pilot partnerships or possible partnerships. Pilot managers at two labs described the establishment of ongoing relationships with small businesses that have sought funding from sources other than SBV:

> *In several cases, small businesses that didn't get the voucher went on and applied for our Technical Assistance program and got a free week of assistance from us.[58] SBV is opening doors. In another case, one of the voucher conversations has led to a partnership [with the small business] and [jointly] applying for a FOA.*
>
> *[Referring to a specific project:] It's been great for the PI and that SB has gone on to seek funding in other areas and they have been very successful. So this collaboration will keep going on beyond SBV.*

Another lab pilot manager characterized the resulting relationships with small businesses as of "enormous" value to the lab. This manager envisions that these relationships will continue independently of the pilot and will help the lab "with our efforts moving forward." The manager foresees continued engagement and potential new partnerships. At a minimum, the manager noted that the lab now has different groups to call upon as a "sounding board" for new programs.

6.1.3 Pilot Benefits to Technology Offices

6.1.3.1 Technology Offices Gain Unanticipated Innovations

The three interviewed Technology Office pilot managers appreciated that the SBV pilot brought to their attention innovations not considered in their technology road maps. The original pilot design concept was more agnostic to the technology road maps than the pilot as currently implemented – that is, the original design led to the selection of top-ranked RFAs within each technology area, irrespective of the Technology Offices'

[58] Section 1.2 discusses various lab Technical Assistance programs available to small businesses.

specific funding plans and responsibilities. Even so, the interviewed Technology Office managers still described receiving new ideas through the voucher selection process, and two managers mentioned specific voucher projects that were not in the purview of their technology roadmaps.

6.1.3.2 Technology Offices Gain an Another Mechanism for Conducting R&D

The Technology Offices are responsible for designing, funding, and managing R&D projects. They work with the labs, universities, and the private sector through a variety of funding mechanisms, including lab calls, FOAs, program opportunity notices, and other approaches. Two of the interviewed Technology Office managers valued SBV for providing them another avenue for conducting R&D. As they explained:

> *SBV allows us to bridge the innovation gap by doing R&D at the national labs. It is one of the simplest mechanisms we have for doing this, because of how we fund the labs, and because it doesn't take as many lawyers as FOAs and other mechanisms do.*

> *SBV adds another vehicle by which we can do these R&D activities. SBV is unique. It adds another dimension to what we can accomplish.*

The third interviewed Technology Office manager spoke of the value of lab involvement with small businesses and the benefits of vouchers in comparison with FOAs in funding small business research:

> *It is valuable to have the labs engaged, to have their expertise, to have their technical experts directly interacting with the small businesses. FOAs will not accomplish the goal of serving small businesses. the SBs. FOAs are burdensome, a ton of work because of due diligence, legal requirements, and other factors. And they're slow.*

6.1.4 Pilot Benefits to All Participating Organizations

Several of the interviewed managers – both from the labs and the Technology Offices – described what they characterized as unanticipated benefits from the pilot in terms of the parties' collaboration and relationships. The collaboration and deepened relationships happened among and between all parties. Interviewed managers described four sets of relationships that deepened during their pilot interactions.

6.1.4.1 Deepened Relationships Among the Labs

While supporting voucher selection, the labs learned about each other's small business and commercialization networks, and also gained a deeper understanding of their expertise, facilities, and research. As characterized by one Technology Office manager,

while collaborating on the pilot, the labs engaged in "more and more fluid" interactions than typical. In the words of another Technology Office manager,

> *One of the unanticipated benefits was getting all these different labs together in a room to identify how to work with another. This will have a lasting benefit.*

6.1.4.2 Deepened Relationships Between the Labs and the Technology Offices

The labs and Technology Offices worked together to understand how the labs would structure assistance to the small businesses considered for vouchers. In doing so, each party learned more about the approach and thinking of the other. Three lab pilot managers described the following:

> *We have had a lot of time to talk with the Technology Offices, not just about SBV, but about what they want or need in general. The types of businesses they want to work with, the types of projects they want to fund. We are having more informal conversations than is typical.*

> *Close engagement between the labs and Technology Offices is valuable. Some Technology Offices are very engaged in the process, and with that comes significant support.*

> *The labs get a chance to work with their counterparts at DOE in a different way. There's a lot of engagement that would not happen otherwise. It's an opportunity to build new relationships.*

6.1.4.3 Deepened Relationships Among the Technology Offices, and between the Technology Offices and EERE's Lab Impact Initiative Team

Through the pilot, the Technology Offices interact with the pilot manager and other members of EERE's Lab Impact Initiative team. Although the Technology Offices have not coordinated their approaches to SBV, there is some discussion among the offices about the pilot; for example, there is a periodic pilot steering committee meeting in which all the offices and labs participate. Said one of the interviewed Technology Office pilot managers,

> *Cross-cutting projects like SBV help with the collaborative environment. It's not made a huge impact, but it has been a helpful and good thing for the organization [EERE]. What makes sense is peers working together across different Program Offices [Technology Offices]. Without SBV, there has been no structural reason for these groups to interact with each other. SBV has helped enable that.*

6.1.4.4 Deepened Relationships Between the Labs and Small Businesses

As intended by the pilot, the labs and small businesses are forging relationships. These relationships are not limited to the execution of the research, but begin when a small business contacts someone at the lab and continues through the voucher selection

process. The words of the SBV pilot manager succinctly capture what all lab pilot managers reported:

> *There has been an incredible amount of engagement with the small businesses.*

6.1.4.5 Infrastructure Development

The SBV pilot has developed extensive, effective infrastructure that serves the small businesses interested in the vouchers, the labs that showcase their capabilities on the website, and the Technology Offices that benefit both from access to small business technology developments and from having Technology Office-funded research showcased through the labs' pages on the pilot website. One interviewed Technology Office manager described this benefit succinctly:

> *The value I see from the pilot is leveraging all the funds across all the Technology Offices to set up the infrastructure. It's great to have the infrastructure in place – to know what small businesses are thinking, to have the reviewers. It would be good to have that mechanism become permanent.*

6.2 RECOGNITION OF THE CHALLENGES

The interviewed lab pilot managers, EERE SBV pilot manager, and Technology Office managers described multiple challenges faced by the SBV pilot in its first year and that continue to influence its outcomes. Examples of the challenges are: concern about what one Technology Office manager characterized as a sub-optimal allocation of resources (discussed in Section 6.2.1.2), tension between solving small business problems and addressing Technology Office needs (see Section 6.2.1.3), providing for pilot administrative costs (see Section 6.2.1.4), release of funds to the labs (see Section 6.2.1.5), and differences between Technology Offices pilot activities (see Section 6.2.2).

6.2.1 Funding

6.2.1.1 Topic Area Budgeted Funds

The nine participating Technology Offices funded the SBV pilot. The offices rightly understand their role as stewards of the taxpayers' money. They have a fiduciary responsibility to use their funding to best accomplish its intended objectives.

The Technology Offices have topic-area budgeted funds – allocated by Congress – each of which corresponds to a unique B&R code. The breadth or narrowness of these topic areas differs due to historical factors among the Technology Offices. In addition to Congressional allocations by topic area, some of the Technology Offices have elected to track their activities at a more granular level, and thus have more B&R codes than required by Congressional appropriations. To participate in SBV, the Technology Offices identified a subset of their topic areas (B&R codes) for which they would award

vouchers. Advanced Manufacturing identified a single B&R code for SBV vouchers, one broadly defined. At the other end of the spectrum, Vehicles chose to accept vouchers using the narrowly defined B&R codes. Regardless of the breadth of the B&R codes, the codes describe the purpose for which those funds must be expended.

There is no B&R code equivalent to "other activities related to the technology but not satisfying the other codes." There are many possibilities for technology-related research that do not correspond to the B&R codes used in SBV and thus cannot be funded by vouchers. The Technology Offices were reluctant to fund requests for assistance for which they could not substantiate a connection to the B&R codes they were using for voucher awards.

To be clear, the Technology Offices have the flexibility to fund small business vouchers to access lab services; they are constrained, however, in the research purposes of those vouchers. Each voucher award must clearly satisfy the B&R code topic constraints.

With these Congressional funding constraints, it is very difficult for EERE to conduct integrated, cross-organizational activities such as SBV. Yet even with these constraints, interviewed managers agree that it is appropriate that the Technology Offices fund the SBV vouchers rather than, say, the Lab Impact Initiative, which does not face the same technology topic area limitations that the offices have. Two key factors make it inappropriate for the vouchers to come through the Lab Impact Initiative. One, the initiative has a limited budget and would be hard-pressed to accommodate the total voucher costs. Two, Rounds One and Two awarded 77 vouchers across nine technology areas comprising about 30 topic areas. It would not be possible for a small voucher team to offer the technical expertise and provide the technical management needed to assure voucher project quality. The Technology Offices have the necessary expertise and management capabilities.

Interviewed managers (lab, EERE SBV pilot manager, Technology Offices) agree that the initial pilot design, as reflected in the SBV Lab Call, had not considered the implications of Technology Office funding and (as planned) lab selection of vouchers, with Technology Office oversight envisioned as veto power. Given the fiduciary responsibilities of the offices, they required an active role for themselves in voucher selection. More than half of the interviewed managers, although not all, see the pilot evolution (described in Section 4.4) as an inevitable result of the funding constraints.

The pilot was challenged during its first two rounds to adjust to the funding realities and the needs of the Technology Offices. Going forward, the interviewed managers anticipate only refinements to, and not large changes in, the relative roles and responsibilities of the Technology Offices and the labs. However, all managers noted that this structure of Technology Office funding has drawbacks as well as benefits.

6.2.1.2 Funding Amounts

EERE needed to allocate pilot funding prior to the launch of any pilot activities, including those of the lead labs. Thus, EERE determined funding amounts by technology and topic areas in advance of knowing the demand for vouchers by these areas.

Sub-optimal resource allocation – the phrasing used by one interviewed Technology Manager – results when voucher awards are limited to the available funding for the topic area, unable to respond to relatively high demands. As described in Section 5.2, as a consequence of the relative supply of and demand for voucher funds, Fuel Cells funded relatively more of the requests it received (it funded 17 vouchers), while Solar Energy funded relatively fewer (4 vouchers). Similarly, within technology areas, the demand for vouchers relative to the available funding differed. To be clear, all funded voucher requests were judged meritorious, and in Round Two were in the top ranked quartile of RFAs; however, the proportion of top-ranked requests that received vouchers differed by technology area and topic area. Variation in awards not associated with a request's merit ranking necessarily results in a sub-optimal allocation of resources.

In addition to the issue of optimal resources allocation, the mismatch between demand and supply (funding) by areas was a source of frustration to both Technology Offices and lead labs. Interviewed managers suggested that, for some Technology Offices, frustration about the mismatch (and the related issue of sub-optimal allocation) undermined support for the pilot by introducing an element experienced by the office pilot managers as randomness into the award selection. From the perspective of lab pilot managers, some focused strongly on the initial pilot vision that the pilot's primary purpose was to meet small business needs. These managers interpreted the mismatched demand for and supply of vouchers as precluding an award distribution that mirrored the gamut of needs put forth by the small businesses.

6.2.1.3 Tension Between Solving Small Business Problems and Addressing Technology Office Agendas

The pilot vision[59] is to meet the technical needs of small businesses working in the clean energy sector by providing access (via both funding and procedural – the pilot processes) to lab resources. In this vision, the small businesses "drive" voucher awards by submitting meritorious requests; the envisioned outcome is that the awarded vouchers reflect the composition of the most meritorious requests received in each topic area.

[59] The vision as conveyed by the SBV Lab Call, by the former EERE SBV pilot manager during the August 2015 kick-off meeting in with the lead labs, and with the current SBV pilot manager who has supported the pilot from its inception.

To this end, at the conclusion of the Round One scoring the lead labs presented to the Technology Offices, the top-ranked voucher requests – about 8% of the requests received. The lead labs had matched these requests with the labs they had identified as most appropriate for the work and specified recommended voucher amounts. Their recommended requests totaled about one-third of the voucher funding established for the pilot's initial three rounds. The labs recommended the Technology Offices award vouchers to the identified top-ranked requests and asked the offices for an "up/down" decision (that is, to approve or reject) each recommendation.

The Technology Offices' response to this award request varied significantly by office. All offices wanted additional information, such as who comprised the pool of reviewers, reviewer's qualitative remarks about the RFAs, the potential work to be conducted, and the scores of the next-highest ranked requests. The envisioned awards process went somewhat as expected for a few of the Technology Offices. These offices requested relatively (in comparison with the other offices) little additional information, had relatively less back-and-forth with the lead labs, accepted most of the labs' recommendations, and concluded the process in relatively less time. At the other end of the spectrum, a few Technology Offices requested extensive information on both the recommended and the non-recommended requests, awarded requests to small businesses among the top-ranked quartile, possibly had considerable back-and-forth with the lead labs, and took more time to conclude the process.

Despite this variation among offices in their Round One voucher selection approaches, all interviewed contacts (lab and EERE) characterized the Round One awards as driven by the Technology Offices – their research needs, technology roadmaps, funding constraints, and non-SBV projects (of any type) underway.

This process and outcome differed to such a degree from that described in the SBV Lab Call and implemented by the lead labs that the pilot changed the Round Two approach. As described in Section 4.4.4, the newly-assigned MR Lab assembled review panels comprised entirely of external experts, many of which were identified by the Technology Offices, labs presented scores and rankings to the offices for all RFAs received, identified the cut-point for the top quartile, and, for this quartile, matched labs to requests and developed and presented to the offices the previously described (Section 4.4.4) two-slide review summary of each request.

The pilot thus evolved from a vision of small-business-driven awards to one of Technology Office-driven awards. The pilot funding by B&R code meant that the degree to which a meritorious request aligned with the funding affected its selection; less closely aligned requests were seldom funded. Thus, awarded vouchers are less representative of the range of meritorious requests submitted and more reflect Technology Office needs and constraints.

While all interviewed contacts (lab and EERE) agreed with the characterization that pilot awards changed from a vision of small-business-driven to an as-implemented reality of Technology Office-driven, contacts varied in their assessment of the benefits and drawbacks of this change. The nine interviewed parties (five lab pilot managers, the EERE SBV pilot manager, and three Technology Office pilot managers) fell into roughly three equal sized groups as characterized by the spectrum of their varied assessments.

At one end of the spectrum, about one-third of the interviewed contacts strongly felt that the loss of the benefits that would flow from a small-business-driven approach substantially outweighed the benefits derived from a Technology Office-driven approach. The converse view was expressed by about one-third of the interviewed contacts. These contacts focused only on the benefits of the Technology Office-driven approach as implemented in Round Two and addressed few, if any, of their remarks to any lost opportunity from the move away from a small-business-driven approach. About one-third of contacts fell between these two ends of the spectrum, pragmatically agreeing that the offices' fiduciary responsibilities require a Technology Office-driven approach, while also valuing what might have resulted were it possible to have a small-business-driven approach.

Although at the time of this writing EERE was implementing the Technology Office-driven approach for Rounds Three and Four, the pilot continues to be subject to a tension between initial vision and current implementation.

6.2.1.4 Administrative Costs

The pilot launched with about $20 million in funding for all pilot activities – voucher award, pilot administration, CAP development, and pilot evaluation. All pilot funding was provided by the Technology Offices in proportion to their budgets. Thus, the Technology Offices needed to pay the administrative costs of the lead labs associated with their technology areas. The administrative costs varied by lead lab, according to the contract it negotiated with EERE in response to its submitted proposal.

Most pilot administrative costs relate to the pilot undertaking as a whole, not to activities conducted in support of any specific technology area. Similarly, most administrative costs did not vary substantially by size of pilot. Outreach varies somewhat, as greater outreach is needed to reach greater numbers of small businesses. The POC support to interested small businesses was driven by the number of phone calls and emails the businesses placed to the labs. Merit review costs were driven by number of RFAs received. One cost does vary somewhat by technology area – the award of vouchers and contracts. For this activity, the more vouchers awarded and the more deliberations the voucher, the higher the costs. In summary, the Technology Offices funded administrative costs related to the pilot overall and their share of pilot funding, but with little relationship to their specific activities.

As reported in Section 4.2, seven of the nine technology areas had two co-lead labs, and two had a single lead lab. Four of the five lead labs led or co-led three technology areas and the fifth, LBNL, co-led four areas. This selection of lead and co-lead labs resulted in seven of the Technology Offices paying their shares of administrative costs to two labs, and all of the lead labs received administrative payments from three or four Technology Offices.

This very complex funding structure required substantial time and attention from all parties (the lead labs, the EERE SBV pilot manager, and the Technology Offices), thus degrading implementation efficiency and requiring managers' time during periods of very high pilot activity, when they had many demands competing for their attention. Thus, the issue of administrative cost funding challenged the pilot in its first two rounds.

During the fall of 2016, outside the purview of this evaluation, EERE added FY2017 money to the pilot to fund Round Three pilots in technology areas whose initial voucher founding was expended and to fund Round Four pilots in all technology areas. At the same time, EERE funded the Lab Impact Initiative to cover the lead labs' administrative costs during FY2017.

6.2.1.5 Funding Source and Release of Funds to Labs

EERE launched the multi-year pilot with FY2015 budget. The Technology Offices and labs needed to hold over FY2015 monies and conduct careful account. The Technology Offices varied in their approaches to this situation. Some Technology Offices released their pilot funds to the lead labs supporting their areas shortly after the lab selection, while other offices released their funds upon voucher award. A few of the implications of this situation are described by two interviewed Technology Office pilot managers as follows:

> *It's hard to have hold-backs come down to our program [the Technology Office]. It creates a lot of work for all of us.*
>
> *Our main concern, which we knew going into the pilot, was how we funded the labs. It was a challenge for us. We had FY2015 funds for both 2015 and 2016 activities. The labs had to carry over the funding. But we did not know in advance the necessary amounts to cover the voucher awards. This created delays in starting some projects.*

As with the challenge of administrative cost funding, this fiscal-year funding challenge degraded administrative inefficiency and involved all parties in tedious accounting activities. In addition, the fiscal-year funding challenge had extended the contracting time required for some projects. As one of the pilot objectives is to reduce the time taken in contracting, these project delays affects a pilot metric.

The challenge is apparently resolved by for the Technology Offices with FY2017 voucher funding, which the offices will pay directly to the voucher performing labs, and the separate FY2017 administrative cost funding.

6.2.2 Technology Office Differences

With a Technology Office-driven approach to voucher award, differences between the Technology Offices have posed a challenge to for pilot. The Technology Offices differ in many respects, including:

- Their genesis and history,
- Their managers, staffing, and work styles,
- The labs with which they most commonly work and thus are most familiar,
- Unique sets of technological challenges,
- Their technologies, and the road maps they've developed, and
- Their funding and funding constraints.

The Technology Offices operate independently of each other. Although there are some inter-office meetings and interactions, as noted in Section 6.1.4.3, the cross-functional SBV pilot has increased inter-office interactions to some degree, at least in the opinion of one interviewed Technology Office pilot manager.

The pilot faces the situation of needing to work with what are essentially nine distinct organizations within EERE. The offices have different philosophies, policies, procedures, personalities, internal relationships, and accustomed way of doing things.

The Technology Offices have varied considerably in their response to SBV. A few offices have been eager participants, while at the other extreme, some offices have reacted with, in the words of one interviewed Technology Office pilot manager, "hostility" and "disinterest" to the pilot due to the "tax" on their program budgets, which are limited in comparison to their visionary road maps, as well as taxing their time.

In working with each Technology Office, the pilot has thus far had to accommodate to the demands and conditions of each. Each office wants to follow its own processes and adhere to its own timelines. Neither the SBV pilot manager nor the Lab Impact Initiative manager have authority to direct Technology Office staffs. Nor does it appear that EERE Headquarters prioritized the pilot sufficiently to provide leadership and direction to the Technology Offices.

Although the pilot has been accommodating a Technology Office-driven approach to voucher selection, the EERE SBV pilot manager and many of the interviewed lab managers emphasized their opinions that for SBV to meet its fundamental objectives, it needs to remain a unified, single program across labs and technology areas, with a single set of small business-facing processes. These objectives, described in Section 1.2, include reducing or eliminating barriers that research has shown make it

difficult for small businesses to partner with the labs. In the opinions of these interviewees, only by offering a single all-comers program will EERE be able to meet its objectives to make the small business sector aware of the labs' availability to assist with their technology challenges and to provide a simple way for the businesses to access that assistance.

The evolution of the pilot to accommodate a Technology Office-driven selection approach has made it challenging for those implementing the pilot (the EERE SBV pilot manager and the lead labs) to maintain a single set of processes and timeline and to keep meritorious small business applicants informed of the process for, and status of, their request. Several interviewed contacts described how managing the differing needs of the Technology Offices has led to confusion among small businesses and the labs and inefficiencies in pilot administration.

6.2.3 EERE Support

6.2.3.1 Executive Commitment and Norming within EERE

Interviewed contacts among all three groups (the lead labs, EERE SBV pilot management, the Technology Offices) expressed the view that SBV lacked sufficient EERE Headquarters commitment. Contacts sited a variety of evidence for their opinions.

Several contacts described that the Technology Offices, and especially the office directors, when presented with the lead labs' Round One voucher award recommendations, did not seem to understand the pilot's purpose or processes. An interviewed Technology Office pilot manager described feeling hampered by not knowing management's rationale in setting the office's SBV budget. Saying "the budget was handed down to us," this manager was not expressing a desire to have been part of the decision making. Rather the manager explained that it was "challenging not to know more" about how the amount had been determined, information that might have influenced the office's assessment of which requests to fund.

Several contacts attributed the negative responses to the pilot conveyed by some Technology Offices to a lack of executive support and enthusiasm for the pilot objectives. Contacts noted that the pilot would have benefited in areas such as increased administrative efficiency, improved Round One working relationships, and shortened turn-around times had executives stepped in to resolve conflicts between the pilot effort and the Technology Offices and to increase the importance of SBV among the offices' many activities.

6.2.3.2 Lab Impact Initiative Management Transitions

Pilot implementation was also hampered by multiple management transitions within the Lab Impact Initiative. From pilot conception to the end of Round One, the initiative

experienced three Directors, the last of which continues to lead the initiative as of the writing of this report. The EERE SBV pilot manager has provided the only leadership continuity for the pilot, having supported the pilot from its conception. The three Lab Impact Initiative Directors have held somewhat differing visions for the pilot, have had differing priorities and management styles, and have established differing pilot procedures.

These management transitions have challenged the pilot. It is noteworthy that the third and current initiative manager came on board at the time of Round One voucher selections, when the pilot experienced a substantial shift away from the pilot design from small-business-driven to Technology Office-driven voucher awards.

Possibly attributable to the management transitions, several interviewed contacts (among the lead labs and the Technology Office pilot managers) expressed the opinion that there was insufficient communication between the Lab Impact Initiative team and the Technology Offices, especially in Round One. This lack of communication also challenged the pilot.

6.2.4 Lead Lab Involvement

6.2.4.1 Role of the Lead Labs

As described in sections 4.3 and 4.4, the role of the lead labs changed substantially from the role described in the SBV Lab Call to the roles worked out in the lab kick-off meeting. The Lab Call strongly suggested that each selected lab would run its own pilot whose small business-facing processes and information would be consistent across the labs. The SBV contracts EERE signed with the labs described a single pilot supported by the five lead labs overall and by one or two labs in each technology area, which was the starting point for pilot development during the kick-off meeting. When planning for Round Two, EERE made a further organizational change and assigned each lead lab a unique role.

The use of multiple lead labs for the pilot overall and co-lead labs for a given technology area created challenges for the project. According to the EERE SBV pilot manager, “pilot administration was originally conceived as being less centralized than it needed to be.” Although all lead labs shouldered significant pilot responsibilities, and arguably the pilot could not have launched publicly so soon after the kick-off without the efforts of many talented, diverse staff, nonetheless many interviewed contacts reported considerable lab and EERE pilot manager staff time was spent coordinating activities spread across five labs.

Changing pilot implementation approaches and, with that, changing lab implementation roles, all created challenges for the project. It commonplace that changing roles and responsibilities within a team can be challenging as people learn about and respond to

the revised expectations for their work. Yet this situation also reflected another challenging aspect of the SBV pilot – it was very complex. Section 4.3.3 gives an indication of the many activities that the lead labs undertook to mount the pilot. EERE "seriously underestimated" (in the words of the EERE SBV pilot manager) the administrative effort that would be necessary to design and implement the pilot.

It is not surprising that roles created based on an initial pilot vision would need to change substantially as that vision changed. Nor is it surprising that EERE's original decentralized design gave way to a more centralized, and in some aspects more standardized, process as the inefficiencies of the extensive coordination required by a decentralized approach became apparent to EERE and the lead labs.

As of the end of Round Two, pilot processes continue to evolve and the EERE SBV pilot manager, with input from the lead labs, continues to better articulate the management role or roles needed for pilot success.

One interviewed Technology Office pilot manager summed up this situation:

> *I'd say that pulling off this program, well, it was very ambitious from an administrative point of view. The Program Offices [Technology Offices], the portal, the agreements, all the accounting – it was a huge challenge. I think the Lab Impact team did an excellent job and worked hard at that.*

6.2.4.2 Technology Offices Are the Labs' Clients

A final situation has some bearing on the pilot that might be considered a challenge. All the interviewed lab pilot managers pointed out that the Technology Offices are the clients for most of their work, which dwarfs in dollars and activity the SBV pilot. The lead labs not only lacked authority over the Technology Offices to define how the voucher selection would occur, on what schedule, and so forth, they instead were acting from a position of deference. Although this deference in itself is not problematic and indeed is to be expected, it made more challenging the absence of EERE Headquarters leadership on the pilot. Some of the lab managers expressed sentiments of feeling tension between their individual responsibilities to articulate a pilot vision and uphold established pilot processes and their need to represent their organization appropriately to its largest clients.

Section 7 Conclusions and Recommendations

Early evaluation findings suggest the pilot is an initial success and is actively responding to lessons learned by the EERE SBV pilot manager, lead labs, and the Technology Offices to improve pilot processes. To be clear, the evaluation period stopped short of the execution of voucher statements of work. Thus, the evaluation findings suggest that the pilot has attained to date the first two of its four goals, and is engaging in activities that would lead to attaining its third goal of technology commercialization. The four pilot goals are as follows, with boldface type used to indicate the two goals attained to date:[60]

1. **Increase engagement between the labs and small businesses** that have high growth potential by providing targeted access and services to further EERE's mission,
2. **Broaden lab awareness of small business technological development** and technical needs,
3. **Encourage labs to recognize and assist** with the successful commercialization of potential technologies across a wide spectrum of application areas, and
4. **Strengthen U.S. economic competitiveness in high-technology industries** to support small business development and job creation.

7.1 CONCLUSIONS

Based on the experiences and perceptions of the interviewed five SBV lab pilot managers, the EERE SBV pilot manager, and the interviewed Technology Office pilot managers, the early evaluation findings suggest the following.

1. **The pilot is engaging small businesses and providing them access to lab capabilities they did not previously have.** Key SBV activities – (1) the website, with its information on lab capabilities by technology area; (2) the CAP portal, with its simple application requirements; and (3) the processes by which vouchers are awarded to meritorious small businesses and contracts are developed and executed – collectively engage and provide access to small businesses. SBV outreach is extensive, lead labs continue to identify new outreach venues, and hundreds of small businesses that have not previously worked with the labs have requested assistance.
2. **The participating labs are learning through their joint review of the top-ranked quartile of small business requests about small business technology development and needs.** Managers at two lead labs engaged in voucher work at the time of the evaluation interviews spontaneously reported that

[60] *SBV Lab Call.*

several of their PIs had obtained new insights from their voucher work that had implications for their non-voucher research.

3. **The labs are very interested in assisting small businesses with their technology innovations.** Fourteen labs are participating in the SBV pilot; twelve labs were awarded Round One and Two projects. The participating labs support an average of nearly five of the nine technology areas. The pilot is involving and publicizing through its website the capabilities of labs that do not have a reputation for clean energy or for economic development, as well as labs that do.
4. **The clean energy sector small business community is very interested in partnering with the labs to solve their technical problems.** By the close of Round Two, 1,748 entities had registered to use the CAP site and 848 small businesses located in 46 states and the District of Columbia had submitted RFAs.[61] Over half of submitting businesses had no prior relationship with a lab. Lab staff that answered the questions of applying businesses reported that many businesses expressed their thankfulness for the opportunity.
5. **SBV appears to be enabling the labs to make a difference to the small business clean energy sector nationwide.** The labs are a national resource, funded by taxpayers. SBV appears to be successful in extending the labs' unique resources to the small business sector. SBV makes it as easy for small businesses to work with a distant lab as to work with a nearby one.
6. **Voucher funding appears to be a key support to the creation of partnerships.** Interviewed contacts noted the role that voucher funding played in enabling the small business to access the lab services. Several labs reported a few small businesses that contacted them for SBV went on to receive non-SBV funding to engage with the lab, again suggesting the importance of the provision of funding to the formation of partnerships.
7. **The cross-cutting SBV pilot has led to new relationships, and strengthened existing ones, between and among the labs, the Technology Offices, and the Lab Impact Initiative.** Nearly all interviewed lab and EERE staff involved in the pilot spontaneously spoke of new and deepened relationships between all parties that have resulted from collaboration on SBV. The lead labs, which historically have seldom collaborated in such an integrated way as necessitated by SBV, reported very strong working relationships with their team members from other labs. All parties credited the EERE SBV pilot manager with skillful, effective management of the challenging pilot.

[61] The pilot received 849 RFAs in Rounds One and Two, but one of these was from an applicant not located in the U.S. or its territories.

8. **The pilot has developed infrastructure that is valued by the Technology Offices and the labs**, and which would decay without some level of ongoing support. For example, the SBV website showcases the capabilities of the labs and, by implication, the research funded by EERE. These capabilities and research projects evolve with time, necessitating revisions to the website content to remain current. As another example, the lead labs have developed and activated an extensive network for pilot outreach. This network would likewise decay if the relationships were not tended to, or if there were no reasons to activate the network.
9. **The pilot offers the Technology Offices another mechanism for funding R&D,** a mechanism uniquely suited for engaging small businesses. All three interviewed Technology Office pilot managers reported this additional mechanism as a substantial benefit that SBV provides.
10. **A Technology Office-driven approach is responsive to the constraints of EERE funding,** yet also narrows the selection of requests for assistance, reducing the number of vouchers awarded to innovations that are not related to the offices' technology road maps. A Technology Office-driven approach moves away from the initial pilot vision that SBV would serve the needs of the small businesses, funding the requests receiving the highest review score regardless of the fit between the businesses' technologies and the Technology Offices' research directions. The parties to the pilot (the EERE SBV pilot manager, the lead labs, the Technology Offices) experience and acknowledge to varying degrees the tension between the goal of a best serving small business needs, whatever they may be, and the goal of best deploying Technology Office funding.

    Findings suggest it is very unlikely that the hypothetical alternative to Technology Office management of vouchers – for example, voucher management by a small program group within the Lab Impact Initiative – would be able to provide sufficient technical direction and management.

    These two findings – (1) the fiduciary responsibility of Technology Offices to best deploy their resources and (2) the inability of a small group within EERE to run the program independently of the Technology Offices, without their technical and managerial direction – leads to the conclusion that the Technology Offices must continue to have responsibility for voucher selection. To avoid a future where voucher awards narrow to the point of simply reinforcing rather than gently challenging the status quo, EERE's challenge will be to determine an approach that remains receptive to unexpected innovative ideas.

7.2 RECOMMENDATIONS

EERE considered the following factors in developing the SBV pilot:

- the importance of small businesses in innovation and job creation,
- the unparalleled resources of the national labs – resources developed largely through taxpayer funding,
- EERE's efforts to increase the labs' commercial impacts and industry engagement, and
- the relatively small proportion of lab-small business partnerships.

SBV has been responsive to these factors, which continue to have relevance. Thus, we offer recommendations for SBV going forward.

1. **DOE should continue SBV in roughly its current form – with appropriate resolution of existing challenges – after the pilot ends.** The pilot uniquely fills a niche created by DOE's objectives to stimulate the commercialization of clean energy technologies, stimulate economic activity, and ensure that the private sector – regardless of firm size – has access to the tax-payer funded, world-class national resource that of the national lab system. DOE should reexamine the decision to continue SBV after SBV project outcomes and impact estimates are more fully assessed by the evaluation team in research through 2020. Current indications from early pilot experiences suggest that small businesses have the potential to reap benefits from their SBV projects.

   Interviewed Technology Office pilot managers indicated that SBV augments the mechanisms available to them to conduct R&D. Multiple contacts spoke of the importance of continuity and reliability, saying that it is hard to plan without knowing whether SBV will continue. The Technology Offices have invested in substantial program infrastructure (the development of a website, outreach networks, application and selection processes, and so on) that is valuable and will decay over time without maintenance.

   DOE might consider offering analogous programs for offices in addition to EERE, or even simply developing office-specific websites describing lab capabilities relevant to partnering.

2. **EERE should commit to SBV as a single, cross-cutting program that engages in a single set of small business-facing processes and timelines across all Technology Offices.** Continue to provide a simple and clear process whereby a small business can approach the labs with a request, have its request assessed on its merit, be matched with an appropriate lab and PI, and have a relatively simple contract developed and executed relatively quickly.

Although in theory the nine Technology Offices could each independently provide funding to selected small businesses to receive lab services, nine separate programs would not be able to conduct the same outreach as does a unified program. And the simplicity and clarity that SBV offers would be lost if small businesses had to route themselves to the appropriate Technology Office website and follow office-specific procedures.

3. **EERE should develop and articulate its strategic vision for SBV.** One facet of the strategic vision might address key program benefits, such as providing access to the resources of the labs to the largest community within the private sector, that of small businesses, and the knowledge transfer and relationship building it promotes among all parties. Another facet of the vision might be an articulation of how the Technology Offices can strategically deploy the various funding mechanisms at their disposal.

   As part of the strategic vision, Headquarters should clarify its position on the spectrum of voucher selection ranging from one extreme of vouchers for assistance with technologies that fully mesh with the Technology Offices' technology road maps to the other extreme of vouchers representative of the technologies for which assistance is requested.

4. **EERE should continue the Technology Office-driven approach for vouchers, yet through its strategic vision and leadership, ensure that the research needs of both small businesses and the Technology Offices are met.** For example, the strategic vision might include SBV's role in identifying innovative, potentially high-impact technologies that are not considered in the offices' technology road maps. EERE leadership might consider requiring or strongly encouraging each office to award a few vouchers (a number relative to its total voucher awards) to such technologies. Alternatively, EERE might fund the Lab Impact Initiative to award vouchers to a handful of top-ranked requests considered but not selected by the Technology Offices and ensure the offices provide these projects with the same technical and managerial attention they provide the projects they award.

5. **EERE leadership should provide greater direction to the Technology Offices regarding SBV and indicate that Headquarters wants to see its success.** EERE should require SBV participation of the nine Technology Offices. The participation of all nine offices is essential to SBV success, and SBV, in turn, has the potential to make a significant contribution to achieving EERE's goal of increasing lab-small business partnerships and thereby increasing lab contribution to technology commercialization in the U.S.

   Headquarters should empower someone to enforce a single program, a program for which all small business-facing processes and timelines are the same across

all Technology Offices. That person should step in to resolve SBV implementation conflicts between the Lab Impact Initiative team and the Technology Offices.

EERE should provide Technology Offices' with metrics for or guidance on selection of vouchers that reflects its program strategy.

In establishing technology area budgets, EERE should again reflect on its strategy for the program, as well as analyze the RFAs received and vouchers awarded during the pilot. While program success necessitates that all Technology Offices need to participate, it may make sense to allow some variation in the proportion of office budget allotted to SBV. A review of the pilot results should inform such a decision. When budgets are established, communicate the rationale for the budget, as well as the strategic drivers, to the Technology Offices.

6. **With EERE leadership support, the Lab Impact Initiative team should increase its communication with the Technology Offices, and engage the labs in thinking more strategically about the top ranked RFAs.** The Lab Impact team should continue to communicate the strategic vision for SBV and voucher selection to the Technology Offices. The EERE SBV pilot manager should help the lab staff engaged in presenting RFAs to the offices to consider the requests from a strategic perspective and persuasively present to the offices reasons why they should invest in a given RFA.
7. **The Lab Impact Initiative team, working with the Technology Offices, should assess the benefits of offering fewer vouchers over $200,000** (one-third of the Round One and Two vouchers). Given a limited SBV budget and the high demand for vouchers, the program must make a trade-off between number of vouchers and average size of voucher. While these higher amounts may indeed be fully appropriate to the requested research and necessary to attain the intended benefits, it may instead by the case that many of these small businesses could achieve significant outcomes with less funding. If the latter scenario holds true, were SBV to award fewer vouchers in excess of $200,000, more vouchers could be awarded. Results from the SBV impact evaluation due 2020 should inform this assessment.
8. **Revisit the Lead Lab program implementation structure.** It appears that program implementation might be streamlined were EERE to work with a central implementation lab, extending an invitation to the other participating labs to be on an advisory council. However, it also appears for multiple reasons that EERE should continue to support the lead labs in conducting program outreach. EERE selected these labs to lead the pilot based in part on their understanding of and their existing networks in the areas of clean energy and commercialization. The

lead labs have expanded their networks during the pilot and have established relationships whose maintenance would be useful to the program. Finally, the labs' outreach activities complement the broader EERE objective for the labs that they become active participants in the commercialization of innovative activities. The relationships the labs have formed for pilot outreach support this objective. Regardless of the ultimate implementation structure, all program roles and responsibilities should be clarified and understood by all parties to the program – the Lab Impact team, the labs, and the Technology Offices.

Appendix A Detailed Logic Models

Figure A-1: Small Business Voucher Pilot's High Level Logic with Metrics

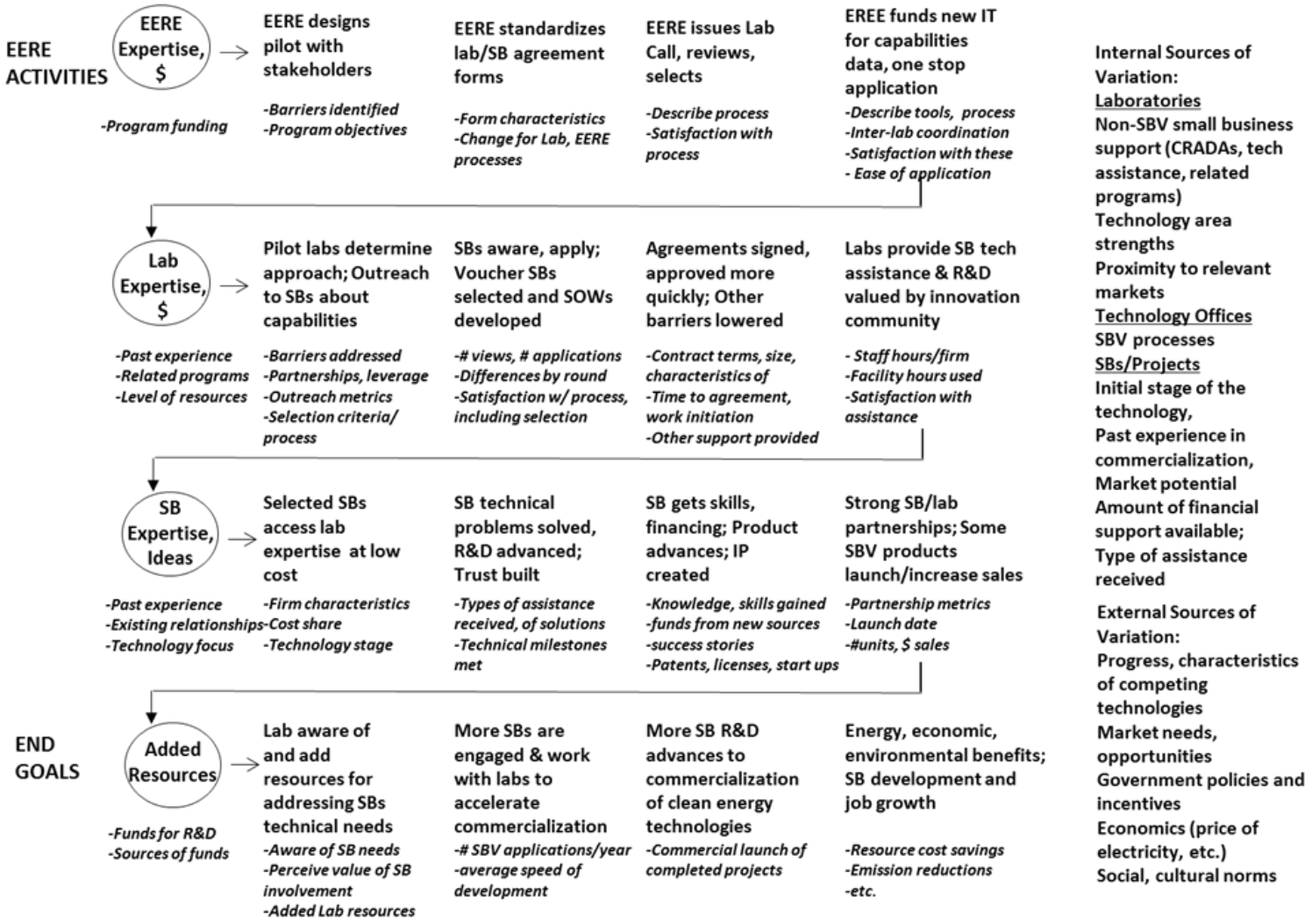


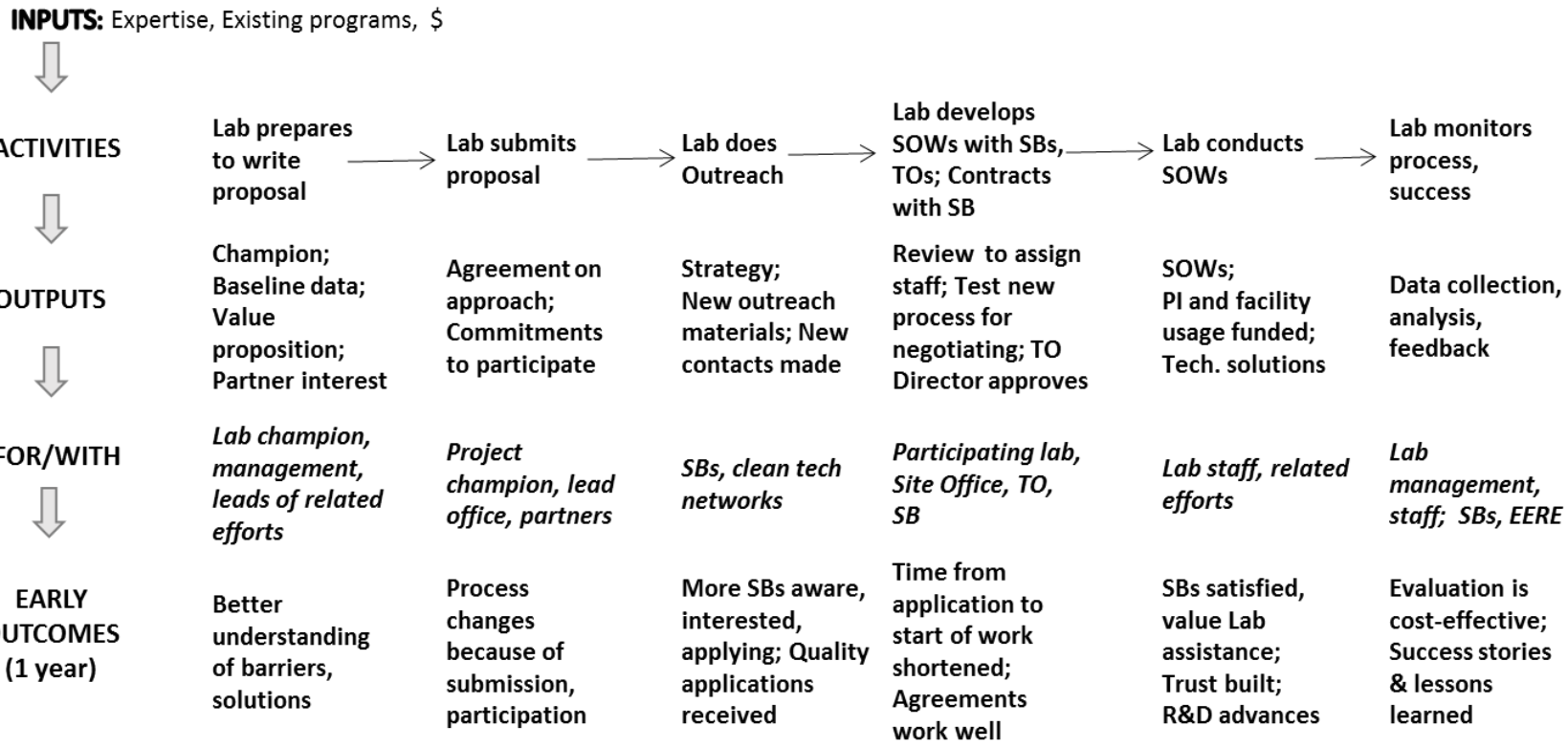
Figure A-2: Small Business Voucher Pilot Logic Model for Headquarters and IT Activities

INPUTS: Expertise, Existing programs, $

ACTIVITIES	EERE designs SBV with stakeholders →	EERE Reviews, selects Labs →	EERE standardizes agreement forms →	EERE via CAP lab develops application portal →	CAP sends applications to labs/reviewers →	EERE monitors, evaluates
OUTPUTS	Lab Call reflecting ways to lower barriers, give Labs flexibility	Lab proposals reviewed on criteria; 5 chosen to lead	Drafts; DOE legal advice; Lab input; SBV CRADA, SBV TAPA	Portal with lab capabilities, on line application form, stored applications	Determine technical & high impact potential; most appropriate lab assigned	Requirements RFQ, select contractor; Tech. plan
FOR/WITH	*Lab management, external experts*	*EERE staff*	*All Lab applicants; DOE General Counsel*	*NREL IT staff*	*EERE Technology Offices; Participating labs*	*EERE program & evaluation staff; Contractor*
EARLY OUTCOMES (1 year)	Labs submit proposals; Have more understanding of barriers and how to lower them	Labs are satisfied with process; Unselected labs participate as nonlead	Time from application to start of work shortened at TO and Lab	Easier for SBs to know why, where, how to apply. More SBs apply	Labs collaborate to determine most appropriate lab	Pilot evolves; Lessons learned; Baseline, process and early impact report

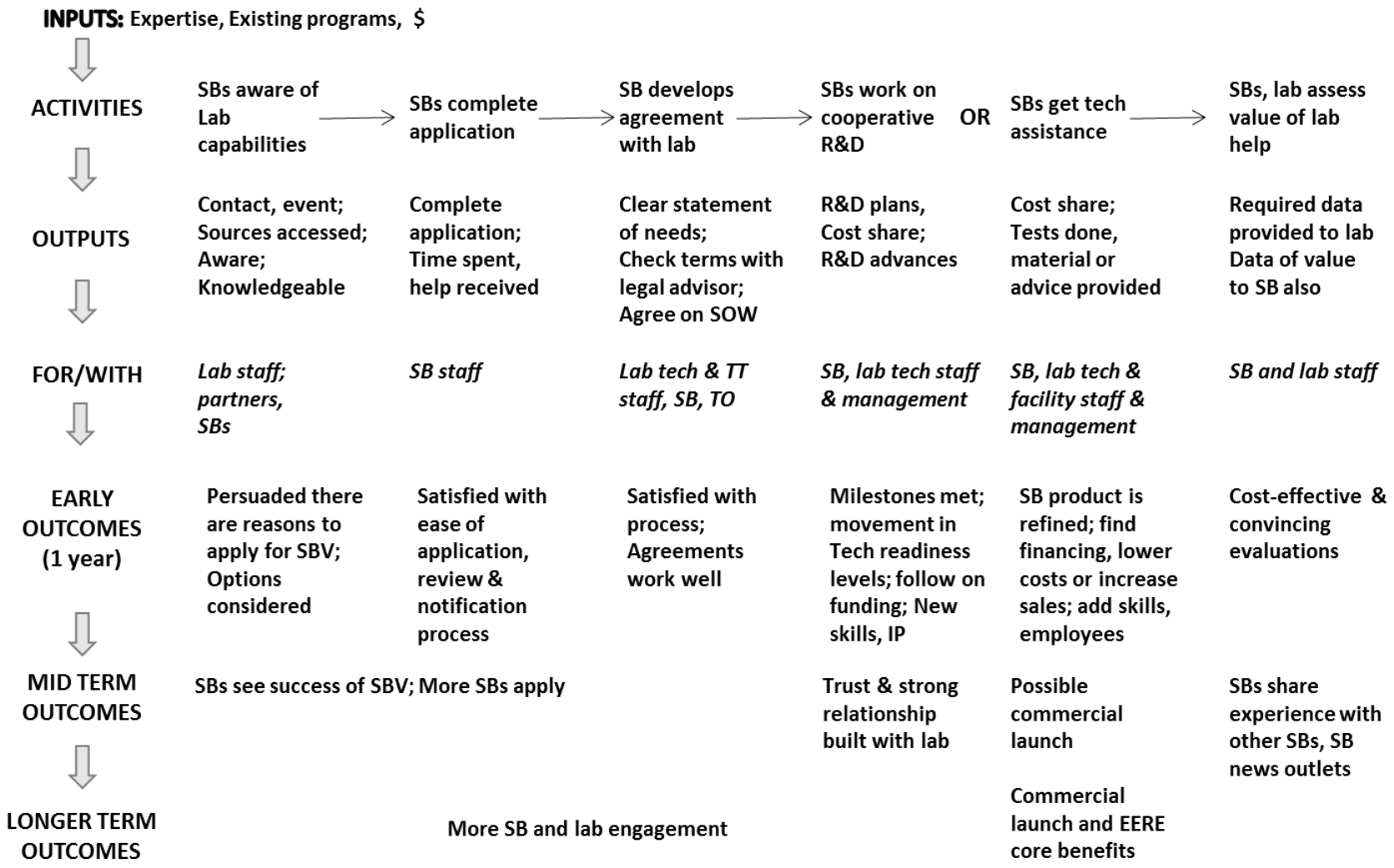
Internal Sources of Variation: Laboratories: Non-SBV small business support (CRADAs, tech assistance, related programs), Technology area strengths, Proximity to relevant markets. Technology Offices: SB processes. SBs/Projects: Initial stage of the technology, Past experience in commercialization, Market potential, Amount of financial support available; Type of assistance received.

Figure A-3: Small Business Voucher Pilot Logic Model for the Pilot Laboratories



Internal Sources of Variation: Laboratories: Non-SBV small business support (CRADAs, tech assistance, related programs), Technology area strengths, Proximity to relevant markets. Technology Offices: SBV processes. SBs/projects: Initial stage of the technology, Past experience in commercialization, Market potential, Amount of financial support available; Type of assistance received.

Figure A-4: Clean Energy Small Business Voucher Pilot's Logic Model for the Voucher Firms



EXTERNAL INFLUENCES: Related programs at each Lab, Progress, characteristics of competing technologies, Market needs, opportunities; Government policies and incentives; Economics (price of electricity, etc.), Social, cultural norms.

Appendix B Factors that Affect Technology Transfer and Commercialization at Federal Laboratories

This appendix describes factors that affect technology transfer and commercialization at Federal laboratories. It draws on finding from a 2011 Institute for Defense Analyses (IDA) study - *Technology Transfer and the Commercialization Landscape for Federal Laboratories*.

1. **Laboratory mission.** Technology transfer varies across laboratories due to the diversity and scope of their missions. Some laboratories are more inclined towards technology transfer that leads to commercialization because it is in the interest of achieving the mission of the lab, agency, or sub-agency.
2. **Laboratory management.** Differences between Government-Owned, Government-Operated (GOGO) and Government-Owned, Contractor-Operated (GOCO) laboratories can affect technology transfer and commercialization activities. GOCO lab leadership is often explicitly tasked to perform technology transfer and commercialization, while GOGO laboratories must comply with certain government regulations that do not affect GOCOs
3. **Congressional support and oversight.** Despite congressional support for technology transfer at the federal laboratories, congressional action and oversight can have the unintended consequence of encouraging a risk-averse culture towards technology transfer. Furthermore, technology transfer activities can be undermined when congressional priorities shift, as technology transfer requires long-term support.
4. **Agency leadership and lab director support.** Support from agency leadership and lab directors can have a marked effect on technology transfer and commercialization activities. For example, lab directors who support technology transfer may provide resources, flexibility, and creative license to their Office of Research and Technology Applications (ORTAs). Those ORTAs who are not supported by their lab leadership can be severely constrained.
5. **Organization and coordination of technology transfer and commercialization activities.** The centralization/decentralization of technology transfer functions at the agency and lab levels affects the speed of implementation of technology transfer actions, the consistency of policies across laboratories within an agency, and the ability to share best practices. The location of ORTAs within an agency and lab can affect the visibility of technology transfer.
6. **Offices of Research and Technology Applications.** Operations that seem to affect technology transfer and commercialization include the responsibilities of

the office; the science, technology, and business expertise of the staff; the processes of the office; and the legal authorities available to the lab and how ORTA staff interpreted them.

7. **Researchers.** Lab researchers, whose participation in technology transfer and commercialization processes varies across laboratories, may lack the knowledge, ability, and incentives necessary to undertake the research, administration, and business development involved in successful technology transfer.
8. **Government-industry interactions.** Federal laboratories are not visible and accessible to industry, and certain regulations make it difficult for federal laboratories and industry to interact. According to partnership intermediaries, groups designed to broker partnerships between the laboratories and industry, industry is largely unaware of opportunities to collaborate with the federal laboratories.
9. **Resources.** Resources devoted to technology transfer and commercialization vary across laboratories and agencies. Further, the extent to which the agencies and laboratories leverage federal, state, and local programs that support technology-based economic development may also affect technology transfer and commercialization.

Appendix C Technology Readiness Level

C.1 TECHNOLOGY READINESS DEFINITIONS

Technology Readiness Level, or "TRL" is a widely-used indicator of degree of development of a technology toward deployment on a scale of 1-9, with 9 being fully deployment ready.

- **TRL 1 Basic Research:** Initial scientific research has been conducted. Principles are qualitatively postulated and observed. Focus is on new discovery rather than applications.
- **TRL 2 Applied Research:** Initial practical applications are identified. Potential of material or process to solve a problem, satisfy a need, or find application is
- **TRL 3 Critical Function or Proof of Concept Established:** Applied research advances and early stage development begins. Studies and lab measurements validate analytical predictions of separate elements of the technology.
- **TRL 4 Lab Testing/Validation of Alpha Prototype Component/Process:** Design, development and lab testing of components/processes. Results provide evidence that performance targets may be attainable based on projected or modeled systems.
- **TRL 5 Laboratory Testing of Integrated/Semi-Integrated System:** System Component and/or process validation is achieved in a relevant environment.
- **TRL 6 Prototype System Verified:** System/process prototype demonstration in an operational environment (beta prototype system level).
- **TRL 7 Integrated Pilot System Demonstrated:** System/process prototype demonstration in an operational environment (integrated pilot system level).
- **TRL 8 System Incorporated in Commercial Design:** Actual system/process completed and qualified through test and demonstration (pre-commercial demonstration).
- **TRL 9 System Proven and Ready for Full Commercial Deployment:** Actual system proven through successful operations in operating environment, and ready for full commercial deployment.

Appendix D National Laboratory Initiatives and Technology Commercialization Initiatives Having Some Indirect Lab Involvement

In addition to the SBV pilot – the subject of this evaluation study – there are other national lab initiatives. Also, there are a number of technology commercialization initiatives that indirectly involve the labs.

D.1 LAB INITIATIVES

D.1.1 DOE's Lab-Corp Pilot (2015 to Present)

Lab-Corps is a U.S. Department of Energy (DOE)-funded pilot intended to accelerate the commercialization of clean energy technologies from DOE national laboratories (labs). Office of Energy Efficiency and Renewable Energy's (EERE's) Technology-to-Market program provided $2.3 million (fiscal year 2015) to launch the Lab-Corps pilot, and received FY 2016 and FY 2017 funding to continue operations. Lab-Corps trains selected lab scientists and engineers in techniques to accelerate technology commercialization. Training occurs in a group setting with extensive individual coaching and feedback provided by experienced entrepreneurs.

D.1.2 Lab-Embedded Entrepreneurship Program (2014 to Present)

Lab-Embedded Entrepreneurship Program (LEEP) provides an institutional home for researchers to build their research into products and train to be entrepreneurs. LEEP is funded by EERE's Advanced Manufacturing Office, and co-managed with EERE's Technology-to-Market Program. LEEP takes top entrepreneurial scientists and engineers and embeds them within the U.S. national laboratories to perform applied research and development (R&D) with the express goal of launching a clean energy business. In addition to technological access and support, LEEP trains innovators to develop entrepreneurial acumen and skills, while introducing them to the ecosystem partners needed to facilitate commercial and investment opportunities. This dual focus on R&D and entrepreneurial development provides innovators with the platform they need to take their ideas from the lab and onto the commercialization pathway.

D.1.3 Agreement for Commercializing Technology (2011 to 2017)

The Agreement for Commercializing Technology (ACT) was created in response to feedback received in a Notice of Inquiry Concerning Technology Transfer at DOE National Laboratories. Initially launched as a three-year pilot program in December 2011, the ACT allows lab contractors to negotiate and enter agreements directly with the private sector sponsors using terms and conditions that are more consistent with

industry practices. These privately sponsored research agreements are performed at the contractor's risk. Under ACT, the contractor may charge those parties additional compensation beyond the direct costs of the work at the lab. Some of the benefits that the contractors offered under an ACT include waiver of Advanced Payment requirements, fixed price contracting, performance guarantees, IP flexibility, and the option for a government research license for subjects' inventions instead of the broader a government use license.

D.1.4 Technology Commercialization Fund (2005 to Present)

The Technology Commercialization Fund (TCF) is a nearly $20 million funding opportunity that leverages the R&D funding in the applied energy programs to mature promising energy technologies with the potential for high impact. It uses 0.9 percent of the funding for the Department's applied energy research, development, demonstration, and commercial application budget for each fiscal year from the Office of Electricity, EERE, Office of Fossil Energy, and Office of Nuclear Energy. These funds are matched with funds from private partners to promote promising energy technologies for commercial purposes. The goal of the TCF is two-fold. First, it is designed to increase the number of energy technologies developed at DOE's national labs that graduate to commercial development and achieve commercial impact. Second, the TCF will enhance the Department's technology transitions system with a forward-looking and competitive approach to lab-industry partnerships. TCF enhance DOE's technology transitions efforts by providing national lab technologies funds for maturation, empowering a broader set of potential industry partners to engage with the national laboratories, and focused industry engagement to identify high-quality partners. EERE is the largest contributor to this program.

D.1.5 Entrepreneur-in-Residence (2007 to 2008)

EERE began its Entrepreneur in Residence (EIR) initiative in 2007 to support clean energy technology commercialization and to address long-standing concerns that national lab inventions were not being sufficiently transferred into the marketplace. After conducting a competitive solicitation, EERE selected venture capital-sponsored entrepreneurs and placed them at key national laboratories. EERE's goal was to accelerate lab technology transfer by enabling start-up entrepreneurs to work directly with the laboratories, thereby bridging the gap between leading scientific and business talent.

D.1.6 Historical Technology Maturation Programs

For more information about the history of DOE technology maturations programs see "Department of Energy Technology Maturation Programs", IDA Science and Technology Policy Institute, May 2013 available at *https://www.ida.org/idamedia/Corporate/Files/Publications/STPIPubs/ida-p-5013.ashx.*

D.2 COMMERCIALIZATION INITIATIVES INDIRECTLY INVOLVING LABS

D.2.1 Build4Scale Manufacturing Training for Cleantech Entrepreneurs (2016 to Present)

The Energy Department's Build4Scale Manufacturing Training for Cleantech Entrepreneurs is a joint effort between the Clean Energy Manufacturing Initiative (CEMI) and the Office of Energy Efficiency and Renewable Energy's (EERE's) Technology-to-Market Office that provides entrepreneurs with the tools they need to identify and address manufacturing challenges early in the process. Understanding how to navigate these challenges saves time and capital, making cleantech startups more attractive to industry partners and investors.

D.2.2 DOE's clean technology university prize competition (Cleantech Up) (2015 to Present)

DOE's Cleantech University Prize (Cleantech UP) aims to inspire and equip the next generation of clean energy entrepreneurs and innovators by providing them with competitive funding for business development and commercialization training and other educational opportunities.

Launched in 2015, Cleantech UP builds on its precursor, the DOE National Clean Energy Business Plan Competition. Eight institutions will host annual Cleantech UP Collegiate Competitions, where students receive entrepreneurial support and compete for cash prizes and services to further support the commercialization of their clean energy technologies. The Collegiate Competitions will establish team development and training that will aid students in developing the skills to move clean energy technologies from the discovery phase to the marketplace. Winners of the Collegiate Competitions will be eligible to compete in the Cleantech UP National Competition. In 2016, the National Competition included a $50,000 voucher at a National Laboratory.

D.2.3 DOE's National Incubator Initiative for Clean Energy (2014 to Present)

The National Incubator Initiative for Clean Energy (NIICE) enables U.S. companies with new clean energy technologies and business models to enter the marketplace or reach commercial readiness faster than before through technical services and connections to industry. NIICE has established a national network of more than 19 different incubators and supporting organizations. Known as the Incubatenergy Network, its members are working together to share best practices and build connections to support entrepreneurs that are driving innovation in clean energy sectors across the nation. Incubatenergy is led by the Electric Power Research Institute in partnership with the National Renewable Energy Laboratory. The initiative also funded several regional incubators that have

attracted leading industry partners to help companies scale up, develop markets, and deploy energy innovations at an expedited rate.

D.2.4 DOE National Clean Energy Business Plan Competition (2011 - 2015)

DOE's National Clean Energy Business Plan Competition built regional networks of student-focused business creation contests across the country, with six regional organizations receiving a total of $ 2 million over three years to host competitions, including $100,000 each in annual prize money for the first-place teams. The regional competitions shared common objectives that included creating a new generation of entrepreneurs to address the nation's energy challenges. The regional winners competed each year for the Grand Prize in a final nationwide Competition. Sponsors of the National Competition included the National Renewable Energy Laboratory.

D.2.5 America's Next Top Energy Innovator (2011 - 2013)

To increase engagement with small businesses, the America's Next Top Energy Innovator Program was launched in May 2011. The program made it easier for start-ups to evaluate inventions and technologies developed at the DOE's national laboratories by lowering the cost of an option agreement for up to three patents for $1,000. An option agreement is a precursor to a license agreement and allows companies time to evaluate the technology and to assemble resources required to commercialize the technology. The option duration was set at 12 months, with the potential for a three to six-month extension. Participating start-ups were invited to enter the America's Next Top Energy Innovator Competition. Each participant in the competition uploaded a short video onto the DOE website, and a public voting competition was held to select the most innovative company. The site received one-half million unique hits. Experts conducted a separate review of the companies and scored them based on their potential economic and societal contributions. The winners of the competition were featured at the 2012 Advanced Research Projects Agency-Energy (ARPA-E) Energy Innovation Summit and had the opportunity to meet the Secretary of Energy.

D.2.6 Energy Innovation Portal (2010 to Present)

The Energy Innovation Portal is a one-stop resource to locate energy-related technologies developed with EERE funding and available for licensing from national laboratories and participating research institutions. Developed and managed by the National Renewable Energy Laboratory (NREL), the Portal was created to simplify access and increase private sector licensing of energy efficiency and renewable energy technologies at DOE laboratories. The Portal contains over 16,000 DOE-created patents and patent applications, providing streamlined searching and browsing of patents, patent applications, and marketing summaries for clean energy technologies. The Portal also allows interested parties to directly contact the licensing representative

from each lab and improves opportunities for "cross-laboratory" intellectual property bundling.

D.2.7 Small Business Innovation Research and Small Business Technology Transfer (1983 to Present)

The Small Business Innovation Research (SBIR) program is a highly competitive program that encourages domestic small businesses to engage in federal research and/or research and development (R/R&D) that has the potential for commercialization. The Small Business Technology Transfer (STTR) program, like SBIR, expands funding opportunities in the federal innovation R&D arena. Unlike SBIR, it requires small businesses to formally collaborate with a research institution. STRR's role is to bridge the gap between the performance of basic science and commercialization of resulting innovations.

In fiscal year 2013, the SBIR/STTR Programs Office within the Office of Science initiated an effort to utilize the SBIR and STTR programs to assist with technology transfer. This initiative, called the SBIR Technology Transfer Opportunity Pilot, was motivated by the opportunity to combine the commercialization objectives of the SBIR and STTR programs with the technology transfer goals of the Department. Participation in the SBIR Technology Transfer Opportunity Pilot is voluntary and covered by an MOU between DOE and the participating research institution.

Appendix E In-Depth Interview Guides

E.1 PARTICIPATING LABS

E.1.1 Introduction

Thank you for taking the time to talk with me today. This interview is for our evaluation report on early findings, intended to inform DOE decisions on any larger roll-out of the SBV pilot. Do you have any questions about our work?

Before we begin, is it alright if I record our conversation to support my note taking? We won't share the recording or notes with anyone outside of the research team. Your comments will be held confidentially.

E.1.2 Management Structure of the Lab's Pilot Activities

Let's begin by talking briefly about your lab's SBV management structure. No need to get to detailed or nuanced. Throughout this conversation, I will be seeking facts – what happened – as well as your experiences with and opinions about what happened. You can keep your responses to the "fact questions" brief. If I need to know more, I will follow up, either during the call or later. Thank you.

Q1. I'd like to know the title and office of each person on the call:

Lab	Name	Title	Office
LBNL			
LBNL			
NREL			
NREL			
ORNL			
ORNL			
PNNL			
PNNL			
Sandia			
Sandia			

Q2. [IF OFFICES DO NOT INCLUDE THE TTO IDENTIFIED BY INTERNET SEARCH, EXPLORE CONNECTION TO TTO]

[OPEN-ENDED RESPONSE]

Lab	Office Identified on Lab Website	Relationship to SBV Activities
LBNL	Innovation and Partnerships Office (IPO)	
NREL	Technology Transfer	
ORNL	Science and Technology Partnerships Directorate	
PNNL	Technology Commercialization Program (Tech Comm)	
Sandia	Partnership Opportunities Office	

Q3. Can you briefly describe each person's role in the pilot and identify any subcommittees they were on?

Lab	Name	Role	Subcommittees
LBNL			
LBNL			
NREL			
NREL			
ORNL			
ORNL			
PNNL			
PNNL			
Sandia			
Sandia			

Q4. Are there any other staff or offices that played significant roles? DESCRIBE

Lab	Name	Offices	Role	Subcommittees
LBNL				
LBNL				
NREL				
NREL				
ORNL				
ORNL				
PNNL				
PNNL				
Sandia				
Sandia				

Q5. Considering all of the offices we've discussed, which were engaged **prior to** the pilot in establishing or supporting agreements with small businesses? [PROBE IF ROLES UNCLEAR]

Q6. How should I refer to the five leadership labs, when I want to distinguish them from the other participating labs?

Q7. How do the responsibilities of the five leadership labs' differ from those of the remaining seven participating labs?

Q8. These answers you are the other labs are providing give me a picture of the pilot organizational structure at the leadership labs, and differences with the other participating labs. Briefly, is there anything else I need to know to understand the pilot organizational structure?

E.1.3 Flow Chart of Activities

In these next sections, I would like to discuss how the rounds soliciting SB proposals were designed and implemented. I've chunked my questions on the SBV process from application through SBV contracts into six chunks – let me know if you see a better way to chunk it:

1. Designing the Notice of Opportunity: Request for Assistance
2. Merit review process
3. Final selection

4. Notification of winners and losers
5. Statement of Work development
6. Ongoing management of SB contracts

Q9. Is there a flow chart you can send me that describes the process (all or part; pilot as a whole or your lab)? IF YES: Please send it.

For each chunk, I have a series of similar questions about what happened, differences between the rounds, and your opinions about the experience.

E.1.4 Designing the Notice of Opportunity: Request for Assistance

Q10. Please briefly describe the process by which the Request for Assistance was crafted. Please call out the roles of labs and DOE, as well as any individuals from your lab. I am asking for the flow-chart view; I'll next ask about your lab's involvement.

Q11. What was your lab's involvement in crafting the Notice of Opportunity: Request for Assistance for each round? Who was involved, in what capacity?

Q12. In what ways did the Notice of Opportunity: Request for Assistance change between Rounds 1 and 2, how did these changes come about, and what were the reasons for the changes?

Q13. What changes, if any, will there be for Round 3? How did they come about? Reasons for changes?

Q14. What have been the implications of these changes for your lab? I am interested in your perspectives on the changes in terms of fit between the pilot and your lab, activities as implementer, and projects selected?

Q15. In your opinion, what are the advantages and disadvantages of these changes?

Q16. In your opinion, how smooth or how challenging were the working relationships during this design process – both relationships among the labs, and between the labs and DOE?

Q17. What, if anything, would you like to see changed in the Request for Assistance?

E.1.5 Merit Review Process

Q18. Please briefly describe the steps in the process from application submittal through reviewed proposal. Please call out the roles of labs and DOE, as well as any individuals from your lab. Again, I want the flow-chart view.

Q19. [IF Q18 CONTACT DESCRIBED A MANAGERIAL ROLE FOR ITS LAB, EXPLORE THOSE ACTIVITIES – Processes for each round, comparison with expectations, as below]

Q20. For the specific reviews that your lab participated in, how was that process organized? Please let me know if that changed from Round 1 to Round 2, and any planned changes for Round 3. [IF CHANGES PROBE:] How did the changes come about? Reasons for changes?

Q21. What about the merit review process went as well or better than expectations and what was more challenging than expected?

Q22. What, if anything, would you like to see changed in the merit review process?

E.1.6 Final Selection

Q23. Please briefly describe how final decisions were made on applications, noting the roles of labs and individuals, and changes between Rounds 1 and 2. Again, the flow-chart view.

Q24. Did your lab participate in any activities associated with the final selection process? IF YES: What were the activities?

Q25. What about the final selection process went as well or better than expectations and what was more challenging than expected with this process?

Q26. What, if anything, would you like to see changed in the merit review process?

E.1.7 Notification of Winning and Losing SBs

Q27. Please briefly describe how applicants were notified of whether they were or were not accepted. Please mention the roles of labs and individuals, and changes between Rounds 1 and 2. Again, the flow-chart view.

Q28. Did your lab participate in any activities associated with notification? IF YES: What were the activities?

Q29. What went about the notification process as well or better than expectations and what was more challenging than expected?

Q30. What, if anything, would you like to see changed in the notification process?

E.1.8 Statement of Work Development

Q31. Please briefly describe how statements of work were developed with voucher awardees. Please mention the roles of labs and individuals, and changes between Rounds 1 and 2. Again, the flow-chart view.

Q32. What was your lab's process to develop contract statement of works?

Q33. What about the contracting process went as well or better than expectations and what was more challenging than expected?

Q34. What, if anything, would you like to see changed in the contracting process?

E.1.9 Ongoing Management

Q35. Are there any ongoing SBV management processes that your lab engages in that we haven't discussed? Both collaboration with other labs and internal processes?

E.1.10 Establishing the Baseline: Differences between the Pilot and Business as Usual

Q36. To what extent do you think the SBV pilot has made it easier and faster for the labs and small businesses to collaborate on commercialization research? [ESTIMATE HOURS WITH AND WITHOUT PILOT]

Q37. To put the pilot projects in perspective, how do the number and types of small businesses your lab has SBV contracts with (Rounds 1 and 2) compare with the numbers and types of small businesses your lab typically works with prior to or outside of the pilot?

Q38. To what pilot features and mechanisms do attribute the change? Stated differently, what value does the SBV pilot offer [Lab] and small businesses that goes beyond existing lab resources?

Q39. We identified commercialization support programs through a review of the websites of the five leadership labs. Let me run through those, to confirm the ones your lab has engaged **small businesses** in in the past 5 years or so. Then I'll ask for anything that I didn't mention.

PROGRAMS	LBNL	NREL	ORNL	PPNL	SNL
CRADA	LBNL	NREL	ORNL	PNNL	SNL
User Facility Agreement	LBNL	NREL	ORNL	PNNL	SNL
WFO (NFS)/ SPP/ Funds-In Agreement	LBNL	NREL	ORNL	PNNL	SNL
SBIR/STTR	LBNL	NREL	ORNL	PNNL	SNL
Licensing Agreements/ SNL IP Licensing Portal		NREL	ORNL	PNNL	SNL
Technical Services Agreement / Technology Assistance Program/ Technical Assistance Program		NREL	ORNL	PNNL	

PROGRAMS	LBNL	NREL	ORNL	PPNL	SNL
Agreement for Commercializing Technology		NREL	ORNL		
Material Transfer Agreements		NREL	ORNL		
Innovation Grants/ Berkeley Innovation Corps	LBNL				
Advanced Manufacturing	LBNL				
Commercialization Assistance Program		NREL			
Tech Comm's Use Permit				PNNL	
Designated Capability Agreement					SNL
Technology Development (Deployment?) Center Agreement					SNL
New Mexico Small Business Assistance Agreement					SNL
Other (describe)					

Q40. Are there any other resources, mechanisms, or opportunities offered at the lab that are dedicated to support small business engagement?

Q41. What outreach and other activity did your lab do to engage small businesses prior to the pilot? How does that compare with your lab's SBV outreach?

Q42. How would you say that your lab's commitment to engaging **small businesses** in CRADAs, TAPAs, WFO agreements, and the like has changed from before the pilot to during the pilot?

Q43. And prior to the pilot, to what extent were congressional, DOE, or EERE directives, lab-specific goals, or individual staff driving the non-pilot small business engagement?

Q44. Were there any other drivers of the lab's non-pilot engagement of small businesses?

Q45. What are some challenges the lab faces in small business engagement or collaboration in the absence of the pilot?

Q46. What change, if any, have you seen in lab staff willingness to engage in SB support? Are there any incentives or disincentives for working with small businesses, and if so, how have they changed, if at all, through the pilot?

Q47. Can you point me to particular publications or reports on past successes of the lab with small business engagement, if any?

E.1.11 Summing Up

Q48. To what extent, if any, has participation in the pilot broadened lab awareness of the technical needs of small businesses that are developing new technical applications?

Q49. Five labs have led the pilot, and all labs working in the targeted technology areas can have voucher projects. How well do you think this structure is working?

Q50. Please describe your lab's satisfaction with process (Lab selection, portal).

Q51. Do you anticipate your lab would conduct any of these activities in the absence of a DOE-sponsored SBV program?

Q52. What's been the main SBV pilot strengths and weaknesses?

Q53. What lessons have been learned to date regarding pilot design and implementation overall (not lessons specific to your lab)?

Q54. Any recommendations for improving the pilot overall?

These are all the questions I have today. Thank you very much for your time.

E.2 EERE SBV PILOT MANAGER AND TECHNOLOGY OFFICE PILOT MANAGERS

What was your involvement in SBV?

What do you see are the benefits of SBV?

What is your assessment of the benefits and drawbacks of how the pilot has changed over time? Probe for assessment of current merit review process.

Are there any changes you would like to see to SBV?

How were the Site Offices involved?

How does pilot funding tied to B&R codes affect pilot processes and outcomes?

What did you think about the pilot funding allocations per B&R code? How did the amounts get set? What consequence did you observe or experience regarding the topic area funding limits?

In your opinion, should SBV continue?

What are the threats to SBV continuing?

[Ask of Technology Office staff] How would you rate your satisfaction with the pilot program on a 0-10 scale?

Do you have any other comments to offer that will help us understand your experiences with, perspectives on, and assessment of the SBV pilot?