

Evaluation of U.S. DOE Small Business Vouchers Pilot

Early Stage Outcomes and Impacts, Round 1, 2, & 3 Awardees

Final Report

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research > into > action^{inc}

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Acronyms

CAP	Central Application Platform
CRADA	Cooperative Research and Development Agreement
DOE	U.S. Department of Energy
EERE	DOE Office of Energy Efficiency and Renewable Energy
IP	Intellectual property
RFA	Request for Assistance
SBIR	Small Business Innovation Research program
SBV	Small Business Voucher
TAPA	Technical Assistance Pilot Agreement
TRL	Technology Readiness Level

Glossary

This glossary defines terms that may be specific to the Small Business Vouchers Pilot.

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. This software is also used to support the storage, retrieval, eligibility screening, and merit review of the requests.
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, 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	<i>Small Business Vouchers Pilot Laboratory Call for Proposals</i> , March 23, 2015.
Principal Investigator (PI)	Serves as the technology team's technical lead and overall project manager.
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.
Small Business Innovation Research Program (SBIR)	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.
Small Business Voucher (SBV)	The SBV pilot provides U.S. small businesses with unparalleled access to the expertise and facilities of DOE's national labs by awarding SBV vouchers valued between \$50,000 and \$300,000 to competitively selected small businesses to cover the cost of lab services.
SBV CRADA	A standard ten-page CRADA agreement developed by EERE (in collaboration with relevant DOE and lab parties) 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 (in collaboration with relevant DOE and lab parties) 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.
Statement of Work (SOW)	Statement of Work (SOW) is a formal document that defines the entire scope of the work involved and clarifies deliverables, costs, and timeline.
Technical Assistance Pilot Agreement (TAPA)	See SBV TAPA, above.
Technology Readiness Level (TRL)	Technology Readiness Level, or <i>TRL</i> , 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).

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). Selected small businesses work with the labs to resolve technical issues that are hindering their technologies (that is, the technology for which they completed a Request for Assistance (RFA), hoping to be awarded an SBV voucher).

The DOE's Office of Energy Efficiency and Renewable Energy (EERE) launched the SBV pilot in March 2015 with a request for lab participation. The pilot comprised three rounds of competitions. DOE announced Round 1 awards in March 2016, Round 2 awards in August 2016, and Round 3 awards in April 2017.

This report presents the early stage outcomes and impacts evidenced by awardees through January 2018, as well as a limited number of process-related findings.

The SBV pilot launched with the following, somewhat overlapping, goals:¹

- **Lab engagement of small businesses:** SBV will increase engagement between the labs and small businesses that have high growth potential by providing small businesses with targeted lab access and services to further EERE's mission.
- **Lab awareness of small business needs:** SBV will broaden lab awareness of small business technology development and technical needs.
- **Lab commercialization assistance:** SBV will encourage labs to recognize and assist with the successful commercialization of potential technologies across a wide spectrum of application areas.
- **Commercialization success:** SBV will strengthen U.S. economic competitiveness in high-technology industries to support small business development and job creation.

An earlier SBV study conducted by the evaluation team addressed the first three of these goals.² Below, we summarize the steps taken to achieve these goals.

Engagement: Through extensive outreach, a website (sbv.org), and a point-of-contact service, the labs engaged over 1,200 small businesses in the SBV pilot across three rounds. These businesses submitted Requests for Assistance (applications for vouchers). About twice the number of applying small businesses signed up as registered users of the website, indicative of broad outreach among the small business community.

Awareness: The labs learned about the technology-related needs of over 1,200 small business through Requests for Assistance submitted by those businesses. The labs also heard from other

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

² RIA, NMR and Gretchen Jordan. 2016. *Baseline and Process Evaluation of Small Business Vouchers Pilot*. DOE/EE-1574. [SBV Baseline and Process Evaluation](#). Statistics presented here are updated to include all three rounds.

small businesses through their extensive pilot outreach activities and via the point-of-contact service, through which they engaged with registered website users.

Commercialization Assistance: The 14 labs participating in the pilot contracted with 114 small businesses to provide them with approximately \$22 million in assistance, supported by DOE's SBV funding across the nine EERE program offices.

Commercialization success: The SBV pilot helps small businesses achieve commercial launch of their SBV technology, which may lead to commercialization success and may subsequently strengthen U.S. economic competitiveness and create jobs.

This report assesses the pilot's early stage outcomes and impacts of labs efforts to address the third goal: Commercialization assistance, and the extent to which SBV technologies reach the commercial market as the initial part of the fourth goal.

SBV provides small businesses with assistance in solving their technology problems.³ The pilot intervention is exclusively focused on technology advancement or refinement and does not address other drivers of commercialization success. Other drivers of commercialization success can be broadly grouped into market factors (describing the technology's fit with the existing market supply- and demand-side actors and conditions) and team-composition factors (describing the traits of the individuals involved in bringing a technology to market).⁴

This study uses the metric technology readiness level (TRL)⁵ to assess small business success in solving their technology problems. The study compares SBV awardees with comparable SBV applicants who did not receive awards (termed non-participants) at the start of the data collection period in 2017.

³ See, for example, the overview description of SBV, which indicates that the pilot will help small "overcome critical technology and commercialization challenges" <https://www.sbv.org/pdfs/sbv-notice-of-opportunity-rfa.pdf>

⁴ See, for example, a report completed under contract DE-SOL-0007898: Energy I-Corps Program: 2017 Case Studies. Research Into Action and Gretchen Jordan. 2018. DOE/EE-1735. https://www.energy.gov/sites/prod/files/2018/02/f49/energy_i-corps_program_2017_case_studies_0.pdf

⁵ The U.S. government developed the TRL metric as a way of assessing the progress of its research and development activities. The metric characterizes technology advancement using nine categories. The categories begin with basic research (TRL 1) and culminate in system proven and ready for full commercial deployment (TRL 9). At times, EERE has included TRL 10 to indicate commercial production. The government settled on the TRL metric as the most practical way to measure development, yet it is an admittedly reductionist approach to assessing a complex, typically iterative environment. Technologies and their paths to development vary widely, with substantial variation in the activities of each level, the length of time each level takes, and whether findings at a later level necessitate returning to an earlier step with refinements. Each TRL level corresponds with a research agenda that concludes with proof that the level has been met and the next level can commence. Accordingly, each level can be further categorized into a design phase, development phase, test phase, and validation. Additional idiosyncratic differences may exist among the developmental activities for technologies at a given TRL.

In addition to TRL advancement, which is the key outcome of the lab-provided assistance, the study reports follow-on funding, an early anticipated outcome; whether the technology has attained sales, an anticipated mid-term outcome; and commercialization success, a later-term outcome described in the pilot goals as encompassing small business development and job creation. The study also considers the creation of intellectual property and development of new knowledge and skills.

STUDY METHODS AND LIMITATIONS

The findings in this report are based on a survey of SBV Round 1, 2, and 3 awardees and a comparison group of unsuccessful Round 2 applicants, about half of which had also applied unsuccessfully to Round 1. The evaluation team conducted the Round 1 survey 21 months after the announcement of the Round 1 awards, the Round 2 survey nine months after the Round 2 award announcement, and the Round 3 survey seven months after the Round 3 award announcement.⁶

The evaluation team compared awardees and non-participants on the pre-pilot characteristics that applicants reported in their RFAs (applications) and in the survey, and concluded that the non-participants constitute an appropriate comparison group for awardees. Awardees and non-participants did not vary statistically significantly in their RFA merit review scores, RFA-reported TRLs, technology type,⁷ prior commercialization experience, firm age, number of employees, or prior interest in and work with the labs. Awardees were somewhat more likely than non-participants to have fuel cell technologies, and non-participants were somewhat more likely than awardees to have solar technologies, but the team found no differences in the groups' outcomes that were correlated with these technology differences.

However, the two groups had a statistically *significant difference* in the current status (at the time of the evaluation survey) of the project they had proposed for SBV funding, with awardees trailing non-participants. Two-thirds of SBV awardees compared with one-third of non-participants had, at the time of the evaluation survey, not completed research on their SBV-related technology. Because a smaller percentage of awardees had completed their research, there may be a short-term and perhaps temporary lag in commercialization outcomes for awardees due to their continued research (rather than moving more directly to commercialization activities).

The evaluation team notes a second study limitation: we attained a small non-participant sample of 35 non-participants compared with 77 awardees. Awardees were more than twice as likely as non-participants to complete the web survey (67% versus 29%). The evaluation team notes that surveys commonly achieve higher response rates among participants (beneficiaries of the program) than among non-participants, who did not receive any program benefit.

The non-participant sample is likely characterized by response bias. The evaluation team thinks it is likely that the group of responding SBV non-participants is, on average, more satisfied with their current situation than the full non-participant population. The team thinks non-response bias has

⁶ The survey was administered to Round 2 awardees and non-participants from May 2017 to June 2017, and to Round 1 and Round 3 awardees from November 2017 to January 2018.

⁷ For both awardees and non-participants, the team refers to the technologies specified in the SBV application as their technology, SBV-technology or SBV-related technology.

likely led to the appearance that non-participant outcomes are better on average than the average outcomes for the full non-participant population.

FINDINGS

Key Early Stage Outcomes and Indicators

Table 1 provides a summary of the key early stage outcomes and indicators of the evaluation. Regarding the goal of the engagement of small businesses, nearly all awardees report interest in continuing to work with the labs and intend to recommend that their colleagues work with the labs (both of these metrics are statistically significantly higher for awardees than non-participants) while more than three-quarters (77%) of awardees reported they developed new relationships as a result of conducting the SBV project. In addition, we note that shortened contracting was an explicit objective of SBV designers and 91% of awardees rated positively the time it took to contract.

Regarding lab commercialization assistance, a statistically significantly higher proportion of awardees advanced at least one level on the technology readiness level scale than non-participants (81% and 43%, respectively). In addition, nearly half of awardees (47%) received follow-on funding and nearly one in five (18%) achieved sales of their SBV-related technology; though higher percentages of non-participants received follow-on funding and achieved sales, the differences are not statistically significant. While the average value of follow-on funding and sales are lower for awardees (compared to non-participants), this may be due to the fact that most awardees are conducting their proposed work with the labs, while most non-participants are running their business as usual, seeking out follow-on funding and readying their technologies for sale without conducting the proposed research geared toward unique lab services.

In addition, 72% of awardees gained knowledge and 43% gained skills as a result of conducting the SBV project, suggesting that the program is having a positive impact on small business knowledge and skills. We also note that the non-participants report statistically higher levels of development of some intellectual property (patents and scientific publications).

As indicated in Table 1, statistically significant differences between awardees and non-participants were not found for satisfaction, follow-on funds obtained, technologies commercially launched, and jobs. Given that the SBV research is in progress, we conclude that it is premature to draw conclusions from the comparison of awardees and non-participants with respect to the later outcomes of the SBV pilot, but that the data on early outcomes provides evidence of success in technology advancement. However, we also note that for some impacts, such as development of intellectual property, non-participants appear to have made more progress than awardees.

Table 1: Early Outcome Metrics and Data Sources (Surveys)

Metric	Indicator	Awardees	Non-participants
Goal: Engagement of Small Businesses			
Satisfaction with contracting: expectations were met or exceeded ¹	Length of time for contracting	91%	40%
Proportion interested in repeated work with lab	Proportion interested in repeated work with lab	89%*	45%*
Proportion recommending to colleagues	Proportion recommending to colleagues	92%*	49%*
Relationships	New relationships formed	77%	----- ²
Goal: Commercialization Assistance			
Technology readiness (TRL) advancement	Advanced at least one stage of development	81%*	43%*
Knowledge	Knowledge gained	72%	-----
Skills	Skills gained	43%	-----
Patents	Patents received (average)	0*	0.8*
Publications	Scientific/Technical publications (average)	0.3*	1.4*
Follow-on funding obtained	Received follow-on funding	47%	60%
	Percent of respondents reporting follow on funding that is private source	25%	40%
	Average. follow-on funding	\$585,000 – 1,245,000	\$1,338,000 – 2,311,000
Technologies commercially launched	Achieved sales of SBV-related technology	18%	23%
	Average sales	\$26,000 – 150,000	\$61,000 – 214,000
Employment effects from technology	Average number of employees, at time of SBV award	13.4	7.6
	Average number of employees, post SBV award	14.2	8.9

¹Non-participant percentages based on the very small subset (n=5) of non-participants that had previously contracted with the labs; thus, we do not assess statistical significance of differences between awardees and non-participants.

²Comparative results for non-participants are not reported, because there were only a few who responded to this part of the study survey

*Denotes statistically significant differences between awardees and non-participants.

Process Findings: Satisfaction with Application Process, Contracting, and Quality of Lab Work

In addition to early stage outcomes and impacts, we report on a limited number of process-related findings. In summary, SBV awardees report high levels of satisfaction with the application portal and process, contracting, and the quality of work with the labs. However, the differences in satisfaction between awardees and non-participants are not statistically significant, though this is in part due to the small subset (n=5) of non-participants that had previously contracted with the labs and were thus asked to rate their satisfaction.

Table 2: Satisfaction with Application Process, Contracting, and Quality of Lab Work

Metric	Indicator	Awardees	Non-participants
Satisfaction with the Central Assistance Portal and application and process ¹	Expectations of the overall funding opportunity notice were met or exceeded	94%	--
	Application process was easier than other federal awards	81%	--
Satisfaction with contracting: expectations were met or exceeded ²	Length of time for contracting	91%	40%
	Expertise of Lab staff involved in contracting	99%	100%
	Treatment of proprietary information	93%	60%
	Contract and Statement of Work process overall	92%	80%
	Understanding of small business needs	88%	80%
Satisfaction with quality of work provided by labs: expectations were met or exceeded ²	Overall voucher project experience	95%	75%
	The expertise of Lab scientists supporting your project	97%	100%
	The quality of the facilities and equipment accessed	96%	100%
	The working relationship with key Lab project personnel	95%	50%
	The fit between your needs (including subjective needs) and Lab services received	90%	50%

¹The study did not seek comparable information from non-participants in the interest of minimizing survey length and burden.

²Non-participant percentages based on the very small subset (n=5) of non-participants that had previously contracted with the labs; thus, we do not assess statistical significance of differences between awardees and non-participants.

*Denotes statistically significant differences between awardees and non-participants.

RECOMMENDATIONS

Based on results from the impact analysis of SBV awardees, we offer the following recommendations:

1. **Maintain the core elements of the SBV program while seeking to achieve ongoing improvement.** As noted above, the vast majority of awardees (81%) are advancing their technologies and sizeable percentages of awardees are receiving follow-on funding and achieving sales. They also report interest in continued work with the labs, and have recommended or will recommend that colleagues work with the labs. Areas of improvement identified by SBV awardees centered around six main themes, the most common of which were budget limitations, response time, and process concerns.
2. **Consider improving the quality of feedback to unsuccessful applicants.** Non-participants very consistently reported that the feedback on their application was inadequate. Providing constructive feedback and following up with unsuccessful applicants will likely improve the quality of future submissions while furthering the goal of engaging small businesses. The Labs might also view the work of providing more thorough feedback to unselected applicants as an opportunity to provide more awareness of other Lab programs or information about Lab expertise, as well as an opportunity to provide more general information about technology commercialization.
3. **Considerations for future research.** The evaluation plan includes ongoing research, culminating in a final evaluation report to be completed in 2020. With feedback from the peer review process, the team has identified several areas for further consideration and examination in the ongoing research, including, but not limited to, impacts of factors such as technology type, starting TRL, size of SBV award, and prior commercialization experience on outcomes. In addition, the team will explore methods to improve response rates from non-participants.

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). Selected small businesses work with the labs to resolve technical issues that are hindering their technologies (that is, the technology for which they submitted a Request for Assistance (RFA), hoping to be awarded an SBV voucher).

DOE's Office of Energy Efficiency and Renewable Energy (EERE) launched the pilot in March 2015 with a request for lab participation. The pilot comprised three rounds of competitions, held from 2015 through 2017.

This report presents the early stage outcomes and impacts awardees evidenced through late 2017, as well as a limited number of process-related findings.

1.1 SMALL BUSINESS VOUCHER PILOT OVERVIEW

The SBV pilot launched with the following, somewhat overlapping, goals:

- **Lab engagement of small businesses:** SBV will increase engagement between the labs and small businesses that have high growth potential by providing small businesses with targeted lab access and services to further EERE's mission.
- **Lab awareness of small business needs:** SBV will broaden lab awareness of small business technology development and technical needs.
- **Lab commercialization assistance:** SBV will encourage labs to recognize and assist with the successful commercialization of potential technologies across a wide spectrum of application areas.
- **Commercialization success:** SBV will strengthen U.S. economic competitiveness in high-technology industries to support small business development and job creation.

An earlier SBV study conducted by the evaluation team addressed the first three of these goals.⁸ Below, we summarize the actions taken to achieve these goals

Engagement: Through extensive outreach, a website (sbv.org), and a point-of-contact service, the labs engaged over 1,200 small businesses in the SBV pilot across three rounds. These businesses submitted Requests for Assistance (applications for vouchers). About twice the number of applying small businesses signed up as registered users of the website, indicative of broad outreach among the small business community.

The SBV website clearly described that the resources of the national lab system are available to the private sector. It also clearly described the capabilities offered by each lab in the nine technology

⁸ RIA, NMR, and Gretchen Jordan. 2016. Baseline and Process Evaluation of Small Business Vouchers Pilot. DOE/EE-1574. [SBV Baseline and Process Evaluation](#). Statistics presented here are updated to include all three rounds.

areas for which SBV offers vouchers. Pilot processes made it easy for small businesses to participate.⁹

About two thirds of applicants were firms with less than six employees. Applicants had been in business for an average of seven years, and awardees an average of eight years. Over half of applicants and one-third of awardees had not previously worked with the lab.

Awareness: The labs learned about the technology-related needs of over 1,200 small business through explanations from those businesses in their Requests for Assistance. The labs also heard from other small businesses through their extensive pilot outreach activities and via the point-of-contact service, through which they engaged with registered website users.

Commercialization Assistance: The 14 labs participating in the pilot contracted with 114 small businesses to provide them with approximately \$22 million in assistance, supported by DOE's SBV funding across the nine EERE program offices (see [Table 3](#), below). 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 (22%, 37%, and 30% of awards, respectively).

An analysis comparing the application-calculated TRLs of applicants who have previously worked with a lab or sought information about the labs and those without such experience or who did not seek information found no differences in the application-calculated TRLs.¹⁰ This 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 (in terms of TRL status). About three-quarters of applicants (both awardees and non-awardees) 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 for voucher use.

Commercialization success: The SBV pilot helps small businesses achieve commercial launch of their SBV technology, which may lead to commercialization success and may subsequently strengthen U.S. economic competitiveness and create jobs.

This report assesses the pilot's early stage outcomes and impacts of labs efforts to address the third goal: Commercialization assistance, and the extent to which SBV technologies reach the commercial market as the initial part of the fourth goal.

⁹ Details supporting this conclusion are provided in the 2016 report. The current study also includes survey findings supporting this conclusion.

¹⁰ We compared the average application-calculated TRL scores between those who had previously worked with a lab to those who had not and between those who sought information and those who had not and found no statistically significant differences. The average TRL scores of those who had previously worked with a lab was 6.14 and those who had not was 6.09 while the average TRL score of those who had sought information was 6.0 and those who had not was 6.5.

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 by helping them overcome critical technology and commercialization challenges, to bolster U.S.-based clean-energy efforts through innovation and public-private partnerships, and to create jobs.

The pilot seeks RFAs (applications) from small businesses that are looking to partner with labs to solve the technical challenges they face in their efforts to bring innovations to market. The selected businesses each receive vouchers for \$50,000 to \$300,000 in services from labs and principal investigators with whom the program team pairs them.¹¹ The paired lab is chosen from among 14 national labs as the lab best positioned to conduct the research.¹² The program team paired a few businesses 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.¹³

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 3](#) provides the SBV funding amounts and the number of projects awarded by technology area.

¹¹ Vouchers are estimated to provide between six weeks and one year of full-time-equivalent research time. A small business may receive more than one voucher, but no more than \$300,000 in voucher funding.

¹² Small businesses can partner with Ames Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, Fermi National Accelerator Laboratory, Idaho National Laboratory, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, National Energy Technology Laboratory, National Renewable Energy Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratory, and Savannah River National Laboratory.

¹³ Cost-share requirements are statutory. Energy Policy Act (EPAct) of 2005, Section 988.

Table 3: SBV Topic Areas and Funding Amounts (\$ millions)

Topic Area	Funding Covers	Total Funding	Projects Awarded
Advanced Manufacturing	Next-generation materials to render factory processes cleaner and smarter	\$6.1	23
Bioenergy	Research and development of renewable biomass resources into commercially viable, high-performance biofuels, bioproducts, and biopower	\$2.6	12
Buildings	Products that reduce energy use or provide demand side management and interoperability in residential and non-residential buildings	\$2.0	11
Fuel Cells	Fuel cell materials and performance; hydrogen production, delivery, and infrastructure technology storage; manufacturing; infrastructure analysis	\$3.1	20
Geothermal	Products that harness energy from enhanced geothermal systems, low temperature geothermal, or geothermal systems analysis	\$0.9	7
Solar Energy	Products and services associated with photovoltaics, balance of system, systems integration, concentrating solar power, and technology to market	\$1.3	9
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	\$2.5	17
Water Power	Products using waves, tides, and waterways for environmentally safe power in marine and hydrokinetics, or hydropower	\$2.2	10
Wind Energy	Products that advance distributed wind or utility-scale wind	\$1.4	6
Total		\$22.2	115*

Source: www.sbv.org

*Total double-counts one business that received two awards from different technology offices. The SBV website reports that 114 businesses have received awards.

The pilot awards vouchers for such activities as the following:¹⁴

- Prototyping
- Materials characterization
- High performance computations

¹⁴ 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.

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

SBV vouchers can be used by awardees to improve performance, test, validate, or address technical challenges of any applicable technology, including technologies that have already achieved sales. In the RFA, applicants reported whether their technologies had attained sales. Neither the RFA nor the evaluation survey asked applicants to summarize the activity as prototyping, materials characterization, etc. Therefore, this study is unable to provide a tally or analysis of projects by activity type.

The pilot comprises multiple rounds of competitions. DOE opened Round 1 for RFAs (applications) in September 2015 and announced awards in March 2016. It opened Round 2 in March 2016 and announced awards in August 2016, and opened Round 3 in October 2016 and announced awards in April 2017.¹⁵

Each round is initiated with pilot outreach (inviting small businesses to apply).¹⁶ The small businesses apply by submitting a short (about five pages)¹⁷ Request for Assistance 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 Central Application Platform (CAP) portal and complete a few steps, including providing contact and other requested information.

The labs and the EERE 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. The application process concludes with the EERE Technology Offices awarding the vouchers to selected small businesses. A given SBV round concludes with the conclusion of all project work.

¹⁵ 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.

¹⁶ SBV was designed to increase lab outreach to small businesses. 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. See RIA, NMR and Gretchen Jordan. 2016. Baseline and Process Evaluation of Small Business Vouchers Pilot. DOE/EE-1574. [SBV Baseline and Process Evaluation](#).

¹⁷ The page length restriction has varied slightly across rounds. Round 1 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 2 and 3 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.

For Round 1, the implementing labs developed a merit score comprised of seven items. Each item was worth between 10 and 20 points; the highest possible score was 100 points. The labs simplified the merit scoring process for Round 2. Reviewers used a three-point scale (equivalent to a *thumbs up*, *thumbs down*, and intermediate score) and assigned points in each of the following three areas (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.

A minimum of two independent expert reviewers scored each submittal for each round.¹⁸

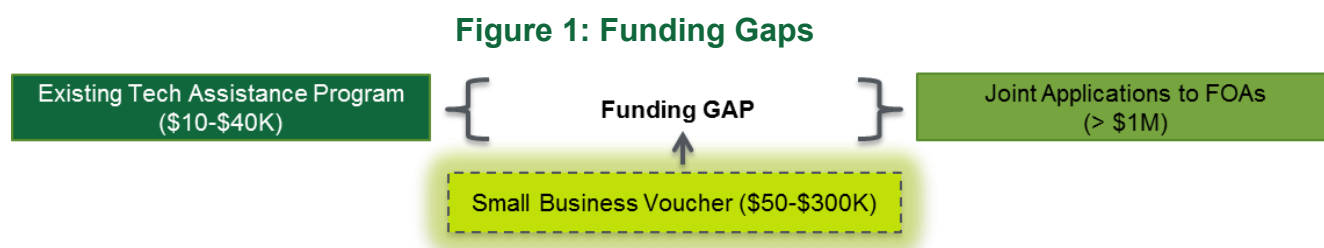
1.2 DOE CONTEXT FOR THE SBV PILOT

The DOE national labs are home to world-class scientists and engineers and house unique, advanced instruments. 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.¹⁹ 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.

¹⁸ From the Baseline and Process Evaluation of Small Business Vouchers Pilot (DOE/EE-1574), page 5: “One knowledgeable lab pilot manager estimated that about half the RFAs received had some merit – that is, described a technical 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 implementing labs ranked the RFAs in decreasing order by merit score. For both rounds, the EERE 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 rounds. The description given here corresponds with the Round 2 process. For Round 2, 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 EERE Technology Offices, the report uses the term *meritorious* in the general sense of having some merit.”

¹⁹ 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*.

Several of the labs have been working with small businesses for the past decade or so to provide access to lab resources to help validate technologies and to provide 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 the New Mexico Small Business Assistance program, supported by Los Alamos National Laboratory and Sandia National Laboratory; the Technical Assistance Programs of Idaho National Laboratory and Pacific Northwest National Laboratory; and the Commercialization Assistance Program of National Renewable Energy Laboratory. 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. EERE designed the SBV pilot to fill an identified gap in funding for mid-size projects, as illustrated in [Figure 1](#).²⁰



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

1.3 COMMERCIALIZATION CONTEXT FOR THE SBV PILOT

Commercialization is hard. "In truth, odds are stacked astronomically against inventors... There are around 1.5 million patents in effect and in force in this country, and of those, maybe 3,000 are commercially viable,' US Patent and Trademark Office spokesperson Richard Maulsby told BusinessWeek in a 2005 interview."²¹ According to inventor Richard C. Levy, "90% of an invention's success is marketing it and getting it out."²² Commercialization success eludes even the most successful companies, as evidenced by The Coca-Cola Company's multiple attempts to introduce new types of Coke. The Harvard Business Review notes that about 75% of consumer packaged-

²⁰ *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.

²¹ Original source not accessible without subscription. Quote by Trent Nouveau, June 9, 2010. <http://www.tgdaily.com/business-and-law-features/50146-us-patent-office-wants-your-hard-earned-cash>

²² Quoted by Liane Hansen, All Things Considered (NPR), "Profile: Independent toy inventor Richard C. Levy," June 18, 2002.

goods and retail products fail to earn even \$7.5 million during their first year.²³ These products attain some level of sales, but never attain the levels of adoption necessary to support ongoing production.

The multifaceted challenges to successful commercialization are explicitly recognized by another commercialization program within DOE's National Laboratory Impact Initiative, Energy I-Corps. This training program instructs and critiques training participants as they think through nine areas considered necessary to commercialize a new technology.²⁴ The training builds on the respected Lean LaunchPad® entrepreneurship curriculum, which business professor Steve Blank developed in response to critiques that traditional commercialization instruction was far too narrow to do justice to the complexity of the commercialization challenge.²⁵

In other commercialization facilitation efforts, business professors Edgett and Cooper, through consulting work with firms such as ExxonMobil and DuPont, developed the Stage-Gate® idea-to-launch process, which their website characterizes as “the world’s most widely-implemented product innovation model.”²⁶ Companies use the thirteen stage-gate criteria to assess their likelihood of commercialization success to guide technology development, including characteristics of the innovation, the regulatory environment, and the target market.

Consistent with the teachings of business schools and consultants, academics studying the success of technology transfer from national laboratories and universities recognize that these organizations have only a limited influence on the commercialization of their innovations. Bozeman and his colleagues have tackled the extensive technology transfer literature through two review papers.^{27,28} In addition to the characteristics of the lab (or university), variations among which we assume exert little influence in the commercialization success of SBV voucher recipients, the model

²³ Joan Schneider and Julie Hall, April 2011. Why most product launches fail. Harvard Business Review. <https://hbr.org/2011/04/why-most-product-launches-fail> April 2011, HBR. The article cites an unnamed “leading market research firm.”

²⁴ The nine areas are key partners and suppliers; key resources needed; key distribution channels, revenue streams, and customer relationships; the technology’s value proposition in words and dollars; customer segments for whom the technology creates value; how to attract and keep customers, including associated costs; best channels for reaching customers; key costs; and development of the revenue model, pricing tactics, and estimation of customers’ willingness to pay for the technology.

²⁵ See Steve Blank, “Why the Lean Start-Up Changes Everything,” *Harvard Business Review*, May 2013. <https://hbr.org/2013/05/why-the-lean-start-up-changes-everything>

²⁶ https://www.stage-gate.com/aboutus_ourstory.php

²⁷ Bozeman, B., 2000. Technology transfer and public policy: a review of research and theory. *Research Policy* 29 (4) 627-655. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.197.3112&rep=rep1&type=pdf>

²⁸ Bozeman, B., H. Rimes, and J. Youtie, 2015. The evolving state-of-the-art in technology transfer research: Revisiting the contingent effectiveness model. *Research Policy* 44, 34-49. <http://www.sciencedirect.com/science/article/pii/S0048733314001127?via%3Dihub>

seeks to account for very large variation among the following commercialization conditions, all of which have substantial impact on the successfulness of the commercialization effort:²⁹

- **Commercializing entity.** The voucher recipients vary widely in scientific and human capital, resources, manufacturing expertise, marketing capabilities, geographic location, diversity, and business strategies, among other things. SBV's applicant selection process excludes evidently unsuitable applicants and seeks to favor well positioned entities, yet the determination is based on limited information. Award applicants vary widely in the quality and quantity of assets they can deploy to commercialize their technologies and the timeframe in which they can deploy them.
- **Technology to be commercialized.** Innovations vary widely in type (including hardware and software), price, complexity, compatibility with existing products and market structures, relative advantage, trialability, and observability, among other things.³⁰
- **Demand environment.** The markets targeted by the technologies might be commercial, industrial, government, or consumer; more likely, the targets are submarkets within these. Markets vary widely and are characterized by such factors as existing demand for a comparable technology (if any), potential for induced demand, costs of competing or complementary technologies, market actor risk aversion, and degree of concentration or monopoly power, among other things.

The SBV program provides selected applicants with vouchers for lab assistance intended to address or reduce critical technical challenges hindering commercialization of their innovations. But technical challenges are simply one of the many types of challenges influencing commercialization success.

²⁹ The Bozeman model includes a fifth element pertinent only to technology transfer out of the lab, which does not describe the SBV program.

³⁰ The last five items in this list are from Rogers' Diffusion of Innovations Model. See: Rogers, Everett M. 2003. *Diffusion of Innovations, 5th Edition*. New York: Free Press.

Section 2 SBV Logic and Study Approach

2.1 THE LOGIC OF SBV IN ADVANCING COMMERCIALIZATION

SBV provides free (via vouchers) technical assistance to selected small business to advance the technological development of their innovations. It provides these small businesses with professional research from expert national laboratory scientists and engineers, and provides them with access to unique, state-of-the-art lab equipment and facilities.³¹

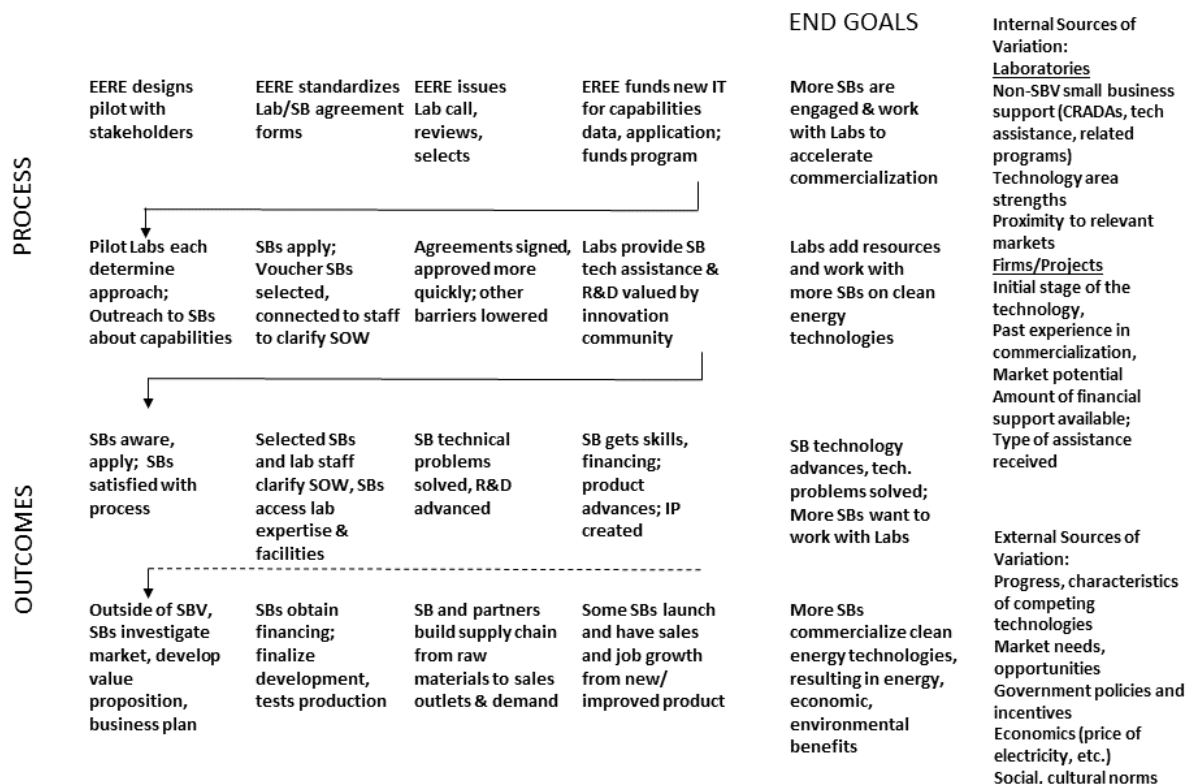
EERE explicitly designed SBV to award grants to small businesses to access services not available through the domestic private sector, in compliance with laboratory foundational legislation. According to DOE, “The Atomic Energy Act of 1954 provides the primary legal authority for DOE to make its facilities available to others, provided that private sector facilities are inadequate to the purpose (DOE facilities are not to be placed in direct competition with the domestic private sector).”³²

Figure 2 illustrates the pilot’s logic.

³¹ <https://www.sbv.org/about.html>. [The pilot makes] the contracting process simple, lab practices transparent, and access to the labs’ unique facilities practical. Through SBV, selected small businesses receive access to the state-of-the-art facilities and experts at participating DOE national labs.

³² DOE P 481.1. <https://www.directives.doe.gov/directives-documents/400-series/0481.1-APolicy/@@images/file>

Figure 2: Small Business (SB) Voucher Pilot Program High Level Logic



2.2 INTENDED OUTCOMES, TESTABLE HYPOTHESES, AND STUDY LIMITATIONS

EERE intends that SBV will advance commercialization among small businesses through the following chain of anticipated outcomes, each of which yields one or more testable hypotheses. The evaluation team first notes two important caveats and limitations affecting all of the study’s testable hypotheses.

2.2.1 Overarching Study Caveats and Limitations

The study metrics assume roughly equal rates of project completion between awardees and non-participants at the time of data collection. In contrast to this assumption, awardees had completed their SBV-related projects at half the rate of non-participants (roughly one-third versus two-thirds).³³

The survey response sample sizes of 77 awardees and 35 non-participants has two implications:³⁴ (1) between-group differences need to be substantial to be statistically significant and (2) the study

³³ See Section 2.4.

³⁴ See Section 2.4 for a fuller description of the sample.

could only conduct limited comparisons of the groups (awardee, non-participant) by secondary factors, such as technology area or previous commercialization experience.

See Section 2.4 for a complete discussion of methods and limitations arising from those methods.

2.2.2 Technology Advancement

Outcome: SBV advances the technological development of a small business's emerging technology. This claim is the pilot's key outcome. It implicitly comprises two components: (1) the technology advances (technological challenges are surmounted) and (2) the technology advances in a manner more satisfactory than that which would occur in the absence of SBV and the lab's unique contributions.

Testable hypothesis: The technical development of SBV technologies exceeds that of comparably meritorious technologies being developed by non-awarded businesses (that is, non-participants) in a given period.³⁵ Technical advancement in this study is measured in terms of technology readiness level (TRL), a widely-used indicator of degree of technology development, as discussed more in Section 2.3.

This study does not include a testable hypothesis regarding whether SBV technologies advance more satisfactorily than comparison technologies. The market place will be the judge of this outcome in years to come.

Study caveats and limitations: The evaluation team makes the simplifying assumption that award amount is not related to TRL advancement. Due to the study's sample sizes of 77 awardees and 35 non-participants and the relatively narrow range of the awards (\$38,000 to \$317,000), the team did not analyze for any influence of the amount of the award on TRL advancement.

2.2.3 Follow-on Funding

Outcome: Investors perceive more technologically advanced innovations as less risky and thus are more likely to fund these technologies. This claim is an early outcome.

Testable hypothesis: SBV technologies receive more follow-on funding than non-SBV technologies. Follow-on funding is both an anticipated outcome and a proxy for the difficult-to-measure risk perception, subject to the following caveat.

Study caveats and limitations: DOE awarded vouchers to small businesses at all levels of technology development. Given the complexity and risk of technology development, it is reasonable to assume that assistance provided for a technology at an advanced TRL is more likely to pave the way for follow-on funding, product launch, and sales success than assistance provided to technologies at earlier levels.

The evaluation team notes that for any competing technologies (that is, technologies that serve a similar function or address a similar market need), funding increases as perceived risk decreases.

³⁵ Implicit in this hypothesis is that awardees and non-participants are equally likely to bring to fruition the technologies they proposed for SBV. This study attempts to satisfy this condition by defining the comparison group as those that had similar merit-review scores as the awardees. See Section 2.4.

However, for non-competing technologies (such as those in different fields like solar and vehicles, or technologies addressing different facets of the same field), follow-on funding is as, or more, likely to be driven by market conditions than driven by perceived risk. This study does not address market niche.

2.2.4 Offered for Sale

Outcome: Technologies that have advanced to the point of market readiness (irrespective of whether follow-on funding was received) are now offered for sale.³⁶ This is the claim that SBV drives commercialization.

Testable hypothesis: A greater proportion of SBV-advanced technologies make it to the market than technologies of comparable non-SBV firms. The study measures “make it to the market” as having achieved sales of any magnitude.

Study Caveats: Again, it is more likely that technologies with higher initial TRLs will attain sales that can be attributable to the SBV intervention than technologies with lower initial TRLs.

2.2.5 Sales Success

Outcome: SBV-advanced technologies that are offered for sale have greater success than other technologies. This outcome comprises two components, which we express as testable hypotheses. The notion of *greater success* describes the market reception of technologies whose final products reflect the contributions of the national labs.

Testable hypothesis: SBV-advanced technologies have greater revenue and employment impacts than comparison technologies.

Testable hypothesis: SBV-advanced technologies have a longer market presence than comparison technologies. They are less likely to be among the vast majority of product launches that have sales for a limited period only.

Study caveats and limitations: Market characteristics are likely to be a more substantial driver of market success than the quality of the technology. The pilot is designed to advance technology quality through lab involvement in solving technical problems. The study does not address market niche. The study also does not explore length of market presence.

³⁶ The authors have structured the progression of outcomes according to readily measured testable hypotheses. The progression of most technologies under development include steps between follow-on funding and products offered for sale. These steps include validating the ability to produce the product at scale and, ideally, assessing market fit.

2.3 ASSESSING TECHNOLOGY ADVANCEMENT BY TRL CHANGE

This study assesses technology advancement through self-reported TRLs.

The U.S. government developed the TRL metric as a way of assessing the progress of its research and development activities. The metric characterizes technology advancement using nine categories. These categories begin with basic research (TRL 1) and culminate in system proven and ready for full commercial deployment (TRL 9).³⁷ At times, EERE has included TRL 10 to indicate commercial production. The government settled on the TRL metric as the most practical way to measure development, yet it is an admittedly reductionist approach to assessing a complex, typically iterative environment. Technologies and their paths to development vary widely, with substantial variation in the activities of each level, the length of time each level takes, and whether findings at a later level necessitate returning to an earlier step with refinements.³⁸

The U.S. Government Accountability Office has developed the *Technology Readiness Assessment Guide* that outlines criteria for evaluating technology maturity and readiness to move past key decision points where major resource commitments are made.³⁹ This guide specifies an approach that uses a team of experts to engage in a replicable process of gathering and evaluating information to make a TRL determination. In contrast, the current SBV study relies on the blunt tool of self-reported TRL assessment (as reported by the small businesses).

DOE awarded vouchers to small businesses with technologies at all different levels of TRL. This study reports two sets of TRL values for each small business: (1) the TRL as calculated by the SBV-pilot according to applicants' responses to a series of questions in their RFA (application) and (2) a set of two TRL scores the business reported in the survey, the TRL at the time of the award and current TRL. Although the RFA-calculated starting TRL values for some small businesses were different from the self-reported TRL values in the evaluation survey, both sets of values show that both awardee and non-participant technologies spanned the gamut of TRL 1 to 9.⁴⁰

This study includes an analysis of the self-reported, evaluation-survey TRL by three broad stages of development: early stage – conceptualization and proof of concept (TRL 1 to TRL 4), mid-stage – validation (TRL 5 and TRL 6), and later stage – commercialization (TRL 7 to TRL 9). The study compares awardees and non-participants with respect to change in number of TRL levels

³⁷ Appendix A defines the TRL levels.

³⁸ Each TRL level corresponds with a research agenda that concludes with proof that the level has been met and the next level can commence. Accordingly, each level can be further categorized into a design phase, development phase, test phase, and validation. Additional idiosyncratic differences may exist among the developmental activities for technologies at a given TRL.

³⁹ <https://www.gao.gov/assets/680/679006.pdf>

⁴⁰ During proposal review, the SBV pilot assigned scores to Round 1 and 2 applicants based on responses to a multi-question battery in the RFA related to the stage of development of the applicant's technology. The application-calculated TRLs were moderately correlated to the self-assessed, pre-SBV TRL scores for Round 2 awardees (Pearson correlation of 0.38); non-participant scores had a stronger correlation to the application-calculated TRLs (Pearson correlation of 0.56). One might hypothesize that experience with SBV leads a small business to more rigorously assess the readiness of its technology. The current study did not assess this hypothesis.

irrespective of starting TRL and movement between early, mid, and late TRL stages since time of voucher awards.

2.4 METHODS

This study assesses SBV’s early commercialization success by comparing the outcomes of SBV awardees with comparable non-participants on the following outcomes:

- Technology advance: SBV’s key outcome
- Follow-on funding: early outcome
- Offered for sale: later outcome
- **Sales success:** ultimate outcomes of total sales, total technology-related employment, and length of market presence

The evaluation team conducted a web survey of SBV awardees and a comparison group, termed non-participants, of unsuccessful Round 2 applicants. Small businesses could apply to more than one round; 15 of the 35 responding non-participants had also applied unsuccessfully to Round 1.

Figure 3 illustrates the timing of the awards and study surveys for each round.

Figure 3: SBV Award and Survey Timeline

Awardee Round	2015				2016												2017												
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Round 1	O						A																						S
Round 2							O					A										S							
Round 2 non-participants																						S							
Round 3														O						A									S

O = Round opens for submissions
 A = Announcement of awards
 S = Survey

The evaluation team used the merit review rating for Round 2 awardees to develop the comparison group. The average merit review rating for Round 2 awardees was 4.35. The team developed the comparison sample of non-participants by establishing a cutoff rating of 3.5, slightly lower than the average awardee rating to ensure a sufficient sample of 121 non-participants.⁴¹ The team was unable to include Round 1 and 3 non-participants in the comparison group due to lack of merit-review data.⁴²

⁴¹ There were 346 non-participants in Round 2 and 1,226 total non-participants across all three rounds.

⁴² The pilot team was able to provide the evaluation team with merit review ratings for approximately one-third of the Round 1 non-participants only, and for none of the Round 3 non-participants.

In [Section 3](#), we compare several characteristics of non-participant firms to each round of surveyed awardees and do not find systematic differences among the rounds and between the non-participants.

Overall, 77 awardees and 35 non-participants responded to the surveys (response rates of 67% and 29%, respectively).⁴³ The 77 awardees who responded include 27 Round 1 awardees, 25 Round 2 awardees, and 25 Round 3 awardees. [Table 4](#) shows response rates by EERE Technology Office.

Table 4: SBV Survey Response Rates as a Proportion of Total Small Businesses

EERE Technology Office	Awardees			Non-participant Sample		
	Total	Number of Responses*	Response Rate	Total	Number of Responses**	Response Rate
Advanced Manufacturing	23	16	70%	26	6	23%
Bioenergy	12	9	75%	10	4	40%
Buildings	11	6	55%	19	3	16%
Fuel Cells	20	14	70%	2	0	0%
Geothermal	7	4	57%	4	1	25%
Solar Power	9	8	89%	20	9	45%
Vehicles	17	13	76%	18	5	28%
Water Power	10	4	40%	13	4	31%
Wind Power	6	3	50%	9	3	33%
Total	115***	77	67%	121	35	29%

*Excludes one awardee who began but did not complete the survey.

**Excludes four non-participants who began the survey but did not respond to any questions and two non-participants who failed to pass survey screening questions.

***Double-counts one business that received two awards from different technology offices. The SBV website reports that 114 businesses have received awards.

2.4.1 Treatment of SBV Rounds

The SBV pilot served an average of 38 small businesses in each of three rounds, with an average of 25 awardees per round responding to the survey; a total of 35 non-participants responded to the survey. From a statistical perspective, these are small numbers. When you further consider the wide variation among EERE technology offices, proposed technologies and small business proposers (discussed further in subsequent sections), and the enormous complexity of the commercialization endeavor (discussed in [Section 1.3](#)), it is clear that these are small samples. The statistical noise threatens to drown the signal of any SBV impact.

This study primarily considers outcomes to date of the SBV pilot in its entirety rather than by round. Most analyses presented in the body of the report compare all responding SBV awardees with responding non-participants. [Appendix C](#) provides results by SBV round. As suggested by the

⁴³ The lower response rate for non-participants may result in non-response errors, as discussed in [Section 2.4](#).

timeline of award announcements and survey efforts (Figure 3, above), this report provides *early* pilot outcomes. Subsequent studies will need to assess later outcomes.

2.4.2 Early Outcome Metrics and Data Sources

Table 5 provides the early outcome metrics addressed by our study.

Table 5: Early Outcome Metrics and Survey Data Sources

Metric	Awardees	Non-participants
Goal: Engagement of Small Businesses		
Satisfaction with application portal and process*	✓	
Satisfaction with contracting**	✓	✓
Satisfaction with quality of work provided by labs	✓	✓
Proportion interested in repeated work with lab	✓	✓
Proportion recommending to colleagues	✓	✓
Goal: Commercialization Assistance		
Proportion for which technology readiness (TRL) advanced	✓	✓
Amount of follow-on funding obtained	✓	✓
Proportion with technologies commercially launched (a sale)	✓	✓
Sales revenues	✓	✓
Employment effects from technology	✓	✓

*Although this metric could reasonably be applied to non-participants, the evaluation team did not include the associated questions in the non-participant survey as part of efforts to maximize response rates by fielding a short survey. In an open-ended question seeking feedback, some non-participants addressed this topic.

**Because the SBV team developed specific SBV contracting procedures as an essential component of the pilot, the study compares awardee SBV experience with the lab contracting experiences of non-participants that had previously contracted with the labs.

In addition to these goal-related metrics, we estimate/assess the following:

- Proportion whose knowledge/skills increased through lab engagement
- Proportion for which intellectual property (IP) was created or licenses obtained
- Proportion engaged in public offerings, spin-offs, acquisition, or mergers

2.4.3 Study Limitations Due to Survey Response and Self-report

This section discusses limitations due to the study's reliance on the voluntary survey participation of awardees and non-participants and on the survey self-report method. Study caveats and limitations of a conceptual nature are discussed in Section 2.2.

All study data were reported by the small businesses, either to DOE through the SBV application process or to us through our web surveys. None of the data are independently verified. Reporting inaccuracies and omissions may have reduced our ability to find patterns in the data and draw inferences and conclusions.

As with any voluntary survey effort, the data reflect the populations willing to respond to the survey and thus possibly suffer bias due to self-selection. Awardees responded to the web survey at more than twice the rate of non-participants (67% versus 29%), an outcome anticipated by the evaluation team; the awardees signed agreements that included a clause requiring contributing to evaluation efforts and they received free lab services, which potentially engendered feelings of indebtedness and an expectation of reciprocity.

Over the course of our research experience, the evaluation team has noted that non-participant contacts, none of which are motivated by reciprocity, most commonly respond to surveys under one or more of the following conditions: they are familiar with the sponsoring organization (a condition met by all SBV applicants), they want to express criticism, or they think they have something especially worthwhile to report. In this study, about half of the non-participants (and slightly more awardees) provided constructive criticism. It may be the case that responding non-participants were more likely than non-responding non-participants to have technology development and commercialization findings they wanted to share.

The appropriateness of the comparison group is central to the investigation and thus reflects a study limitation. As one can only assess its appropriateness from an analysis of the study data, the team addresses this topic in the next section.

Section 3 Appropriateness of the Comparison Group

This section assesses the appropriateness of the comparison group from two perspectives: Round 2 versus Rounds 1 and 3 (to identify any biases that might result from lack of Rounds 1 and 3 non-participant data) and non-participants versus awardees.

3.1 ROUND 2 NON-PARTICIPANTS AS REPRESENTATIVE OF ALL ROUNDS OF NON-PARTICIPANTS

As described in Section 2.4, we surveyed non-participants from Round 2 only because we lacked merit review scores for Round 1 and 3 non-participants, and our desired comparison group was non-participants that scored comparably to participants. Therefore, we assess the representativeness of Round 2 non-participants by examining differences between the characteristics of the different rounds of awardees.

Appendix C provides a detailed examination of all groups: awardees by rounds and non-participants. We found no statistically significant differences among awardees by round for the following characteristics:

- Size of firm (number of full-time employees)
- TRL (score determined by the pilot using responses to the RFA questionnaire)
- Previous commercialization experience
- Type of technology
- Interest in and partnerships with labs prior to SBV
- State of project completion

Awardees differed statistically significantly by round for only two characteristics:

- Self-assessed TRL level at the time of the SBV award (evaluation survey)
- Age of firm (R1 only)

3.2 NON-PARTICIPANTS AS COMPARISON TO AWARDEES

This section assesses non-participants as a comparison to awardees, investigating the following:

- Technology readiness as reported in applicant's request for assistance
- Type of technology (software or hardware)
- Firm's prior commercialization experience
- Ages and sizes of firms
- Interest in and partnerships with labs prior to SBV
- State of completion at time of survey of project proposed in RFA

3.2.1 Technology Readiness per Request for Assistance Submittal

The pilot team awarded vouchers to applicants based on the work proposals and other information they submitted as part of the RFA (application). SBV awardees and non-participants were not statistically significantly different in the technology readiness levels for the proposed technologies,

as scored by the pilot team from applicants' responses to a series of questions (Table 6).⁴⁴ As reported in Appendix C, there are no statistically significant differences among the three rounds of participants and non-participants.

Table 6: Technology Readiness Level (TRL) per RFA Submittal

TRL Metrics	All SBV Awardees (n = 61*)	Non-participants (n = 35)
Minimum TRL	0.0	0.0
Maximum TRL	9.0	9.0
Mean TRL	6.4	5.6
Median TRL**	7.1	7.1

* TRL was only available for nine of the 25 Round 3 awardees.

**The algorithm used to score an applicant's TRL assigned TRL values of 0.0, 2.6, 4.4, 4.7, 7.1 and 9.0.

Awardees and non-participants were at relatively advanced stages of technology development according to their applications to SBV (Table 7). About one-third (36%) of awardees and one-quarter of non-participants (26% or nine non-participants) reported achieving sales of some kind related to their SBV-technology before applying to SBV.⁴⁵

Table 7: Technology Status Questions from SBV Application

SBV Application Question	Percent Yes	
	Awardees (n = 61**)	Non-participants (n = 35)
Have you demonstrated the feasibility of the technology in the lab?	95%*	83%*
Have you created and tested (or are in the process of testing) a prototype?	84%	77%
Have you demonstrated/Are you currently demonstrating the product/service in an initial pilot project or demonstration?	57%	54%
Have you achieved sales – more than one – and are actively seeking more sales?	36%	26%

* Statistically significantly different at the 90% confidence level.

** Technology status application data was only available for nine of the 25 Round 3 awardees.

⁴⁴ The pilot developed a TRL score for each technology through applicants' responses to a series of questions about their technologies.

⁴⁵ Note that these questions are similar to the TRL technology development stages reported in Figure 18, but while Table 7 is reporting individual achievements pertaining to their technology, Figure 18 is reporting respondent's overall assessment of the stage of development of their technology.

3.2.2 Type of Technology

The technologies proposed to SBV vary widely and defy categorization attempts as each of the awardees' and non-participants' technologies is inherently unique. A simple categorization into software and hardware must suffice.⁴⁶ Awardees and non-participants are not statistically different with respect to technology type, although awardees have a somewhat larger proportion of hardware technologies than non-participants (Table 8). We note that software technologies typically have a shorter developmental cycle (time to market) than hardware technologies.

Table 8: Technology Type

Technology Type	Awardees (n = 77)	Non-participants (n = 35)
Technical process development, data modeling, and system design (software)	35%	49%
System design, materials testing, and manufacturing (hardware)	64%	51%

3.2.3 Prior Commercialization Experience

SBV awardees and non-participants reported similar previous commercialization experience (Figure 4). Roughly half of both groups (52% and 40%, respectively) reported that one or more members of their staff had taken a course on commercialization. Over three-quarters of both groups (77% and 77%) said that one or more company staff had previously taken one or more technologies to commercialization. As reported in Appendix C, there are no statistically significant differences among the three rounds of participants and non-participants

⁴⁶ This simple categorization distinguishing software from hardware technologies is consistent with that used by Department of Energy Technology Transfer Working Group Reporting and Appraisal Guide for DOE Technology Transfer Activities.

Figure 4: Firms Previous Experience with Commercialization



3.2.4 Ages and Sizes of Firms

Both SBV awardee and non-participant firms are about eight years old on average (Table 9, per RFA data). One non-participant is an apparent outlier by age, reportedly established 40 years ago. Both awardees and non-participant firms employ an average of 12 to 15 people on a full-time equivalent basis. Again, one non-participant is an apparent outlier, reporting 300 employees.⁴⁷ Note that Table 9 is reporting data from the RFA, which only includes data on nine of the Round 3 awardees, whereas the findings on size of firms reported in Section 5 use data from the evaluation survey.

⁴⁷ The outliers by firm age and size are not the same firm.

Table 9: Age and Size of SBV Awardee and Non-participant Firms

Age and Size Metrics	All SBV Awardees (n = 61*)	Non-participants (n = 35)
Age of Firm		
Minimum Age	1	0
Maximum Age	24	40
Mean Age	8	8
Median Age	6	5
Full Time Employees (FTEs)		
Minimum FTE	0	0
Maximum FTE	63	300
Mean FTE	12	15
Median FTE	6	4

* Firm age and FTE were only available for nine of the 25 Round 3 awardees.

3.2.5 Interest in and Partnerships with Labs Prior to SBV

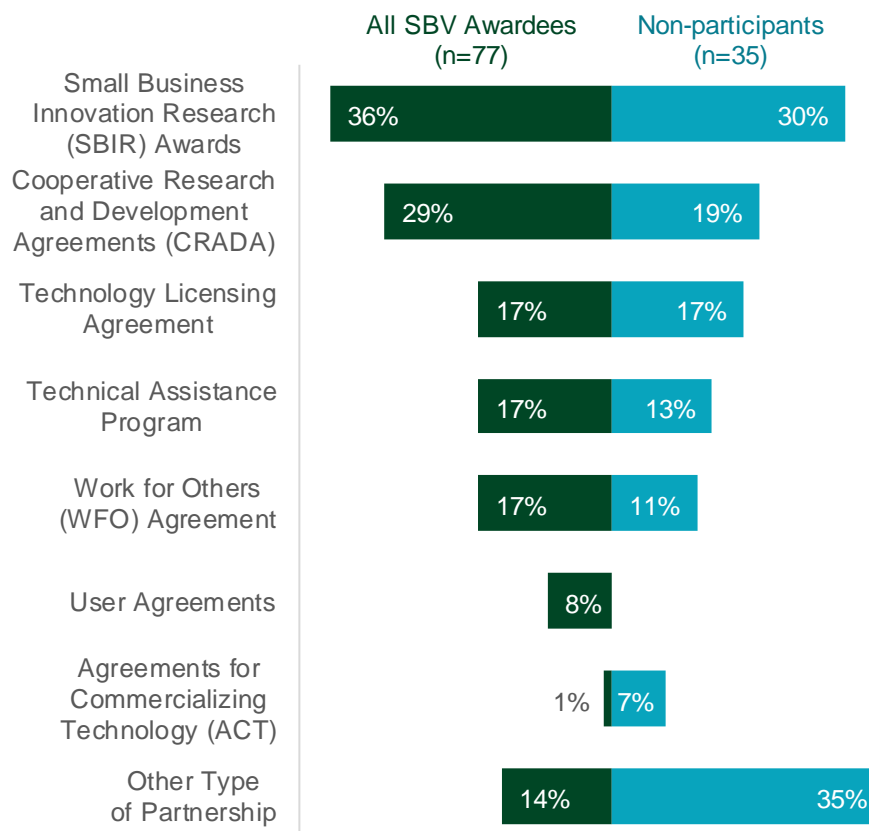
Most awardees (87%) and non-participants (89%) had sought information about energy-related technologies, facilities, or staff expertise at a Lab before applying for SBV or current CRADA, as shown in [Figure 5](#).

Figure 5: Sought Information About Energy-Related Technologies, Facilities, or Staff Expertise at any U.S. DOE Laboratory Before SBV Pilot or Application for SBV



Most awardees (75%) and non-participants (66%) had a previous Lab partnership or had worked with a Lab (before SBV). The most common types of previous Lab partnerships among awardees were Small Business Innovation and Research (SBIR) awards (36% of awardees) and CRADAs (29% of awardees). Just under one-third (30%) of non-participants had an SBIR award before SBV, and over one-third (35%) had another type of partnership or arrangement ([Figure 6](#)).

Figure 6: Lab Partnership or Work Before SBV Training or Application to SBV
(multiple responses permitted)



Several awardees and non-participants specified their ‘other’ type of Lab partnerships, ranging from formal awards with Cyclotron Road or the New Mexico Small Business to informal working arrangements (Table 10).

Table 10: Previous Lab Partnerships

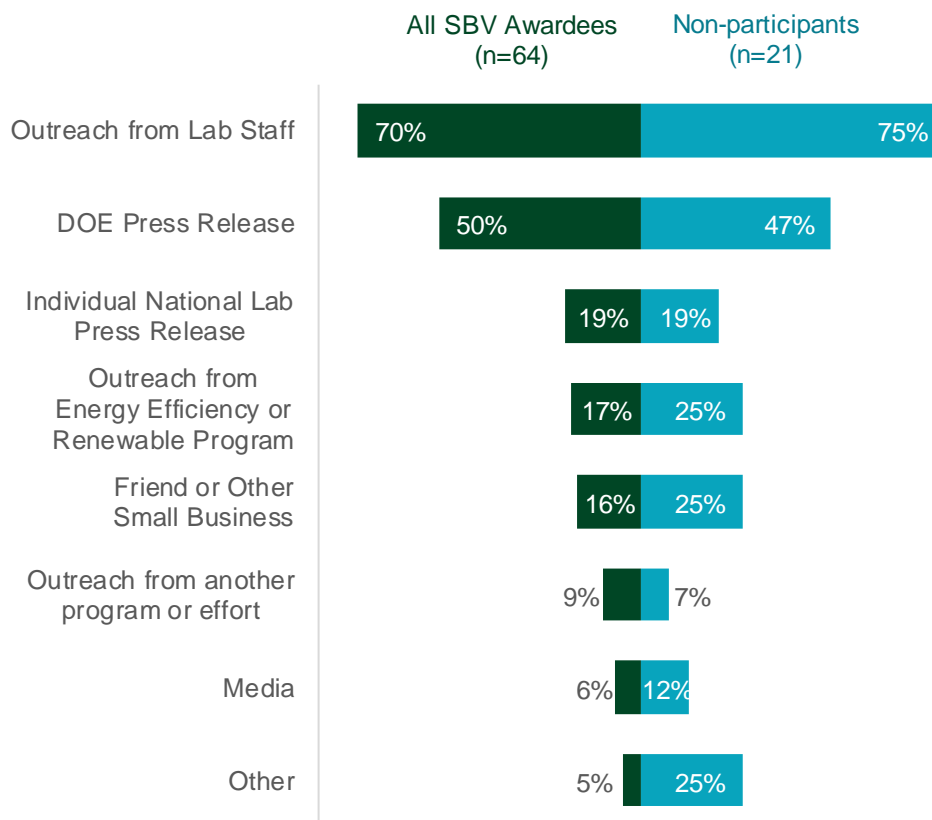
Metric	Awardees	Non-participants
Another Award		
Cyclotron Road*	✓	✓
Seedling Grant	✓	
New Mexico Small Business Assistance**		✓
Unspecified DOE Award		✓
Formal Working Arrangement		
Team member was formerly a lab employee	✓	✓
Subcontractor	✓	
Paid for use of lab equipment	✓	
Consultation		✓
Unspecified R&D collaboration		✓
Informal Working Arrangement		
Sharing samples/materials for lab testing	✓	✓
Coordination at conferences	✓	
Proposal collaboration	✓	
General informal working relationships		✓

*Cyclotron Road is an early-stage energy technology incubation program at Lawrence Berkeley National Laboratory (<http://www.cyclotronroad.org/>).

**The New Mexico Small Business Assistance (NMSBA) Program is a small businesses program supported by Los Alamos and Sandia National Laboratories (<http://www.nmsbaprogram.org/>).

SBV awardees and non-participants most often said they learned about their earlier Lab partnership through outreach from Lab staff (70% and 75%, respectively) or a press release from DOE (50% and 47%, respectively) (Figure 7).

Figure 7: How Firms Learned About Pre-SBV Lab Partnership Opportunity
(multiple responses permitted)



3.2.6 State of Project Completion

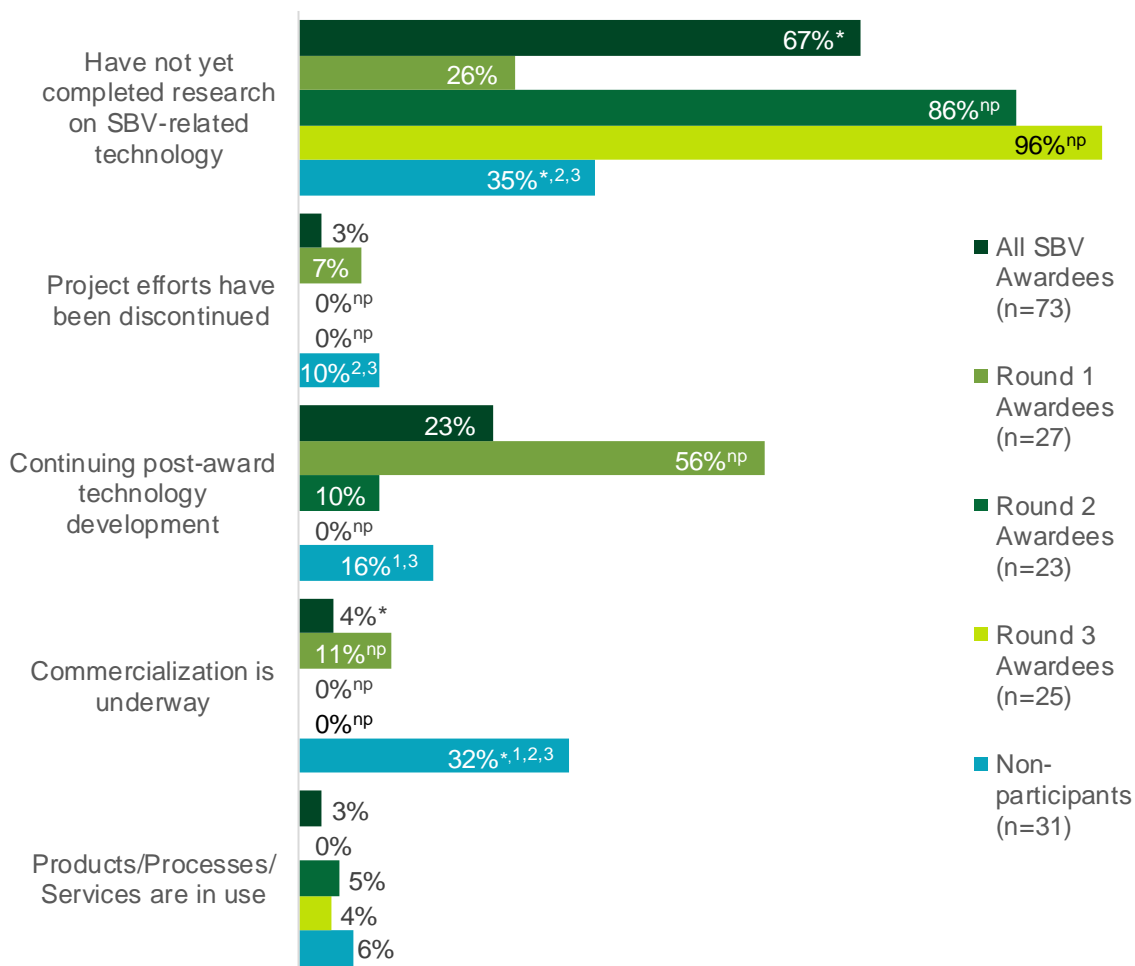
While SBV awardees engage in contracting with the labs and undertaking their proposed work, the non-participants are running their business as usual. Prior to the SBV opportunity, they had been engaged in technology development and, in most cases, they continued that development after the award announcement. But while the awardees are engaging in research that can be executed only with the unique scientists, engineers, and facilities the labs offer, the non-participants must get on with the business of readying their technologies for sale without conducting the proposed research geared toward unique lab services.

Although the awardees and non-participants did not vary statistically significantly in RFA-reported TRLs, type of project, prior commercialization experience, firm age, number of employees, and prior interest in and work with the labs, they statistically significantly differed at the time of the survey in the status of the project they proposed for SBV funding (Figure 8). Note that this metric obscures fundamental differences between the project as designed, which assumes an SBV award and the resulting unique lab contributions, and the projects the non-participants must complete to ready their technologies for market without those unique lab contributions.

Twenty-three percent of awardees and 16% of non-participants were continuing with technology development at the time of the survey. Examining the technology status by round, we see that awardees appear to be progressing from working on their SBV research to continued technology

development, whereas non-participants were more likely to move to commercialization stages, perhaps as a result of not winning the SBV award. Overall, 90% of awardees have either not completed their SBV funded research or are continuing post-technology development, compared to 52% of non-participants (a statistically significant difference). Similarly, nearly four in ten non-participants (39%) have moved to commercialization or achieved sales with their technology compared to 7% of awardees, a statistically significant difference. Additionally, 10% of non-participants have discontinued working on their SBV-related technologies compared to 3% of awardees.

Figure 8: Status of SBV/Non-SBV Project



* Statistically significantly different at the 90% confidence level.

Section 4 Findings: Engagement of Small Businesses and Process Findings

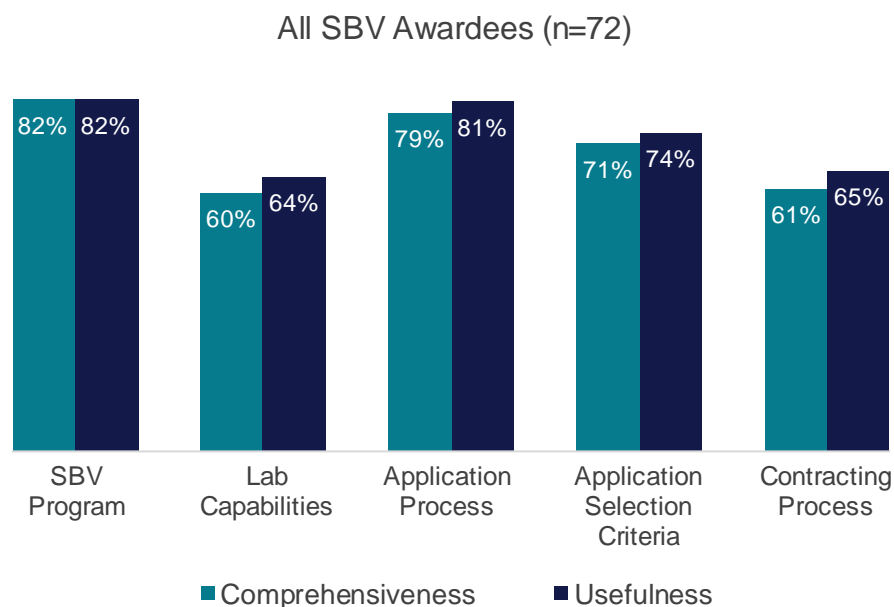
This section discusses findings related to the pilot’s first goal, “engagement of small businesses.” These findings augment those presented in the 2016 SBV evaluation report.⁴⁸

4.1 SATISFACTION WITH APPLICATION PORTAL AND PROCESS

4.1.1 Awardees’ Experience with Central Assistance Portal (CAP)

The majority of SBV awardees found the Central Assistance Portal (CAP) on the whole to be comprehensive and useful for addressing topics such as the SBV program, the contracting process, application selection criteria, the application process, and lab capabilities (Figure 9).

Figure 9: Comprehensiveness and Usefulness of the Topics Addressed on the SBV Central Assistance Portal*



*Percent that gave a *four* or *five* rating on a five-point scale, where one is *not at all comprehensive/useful* and five is *very comprehensive/useful*.

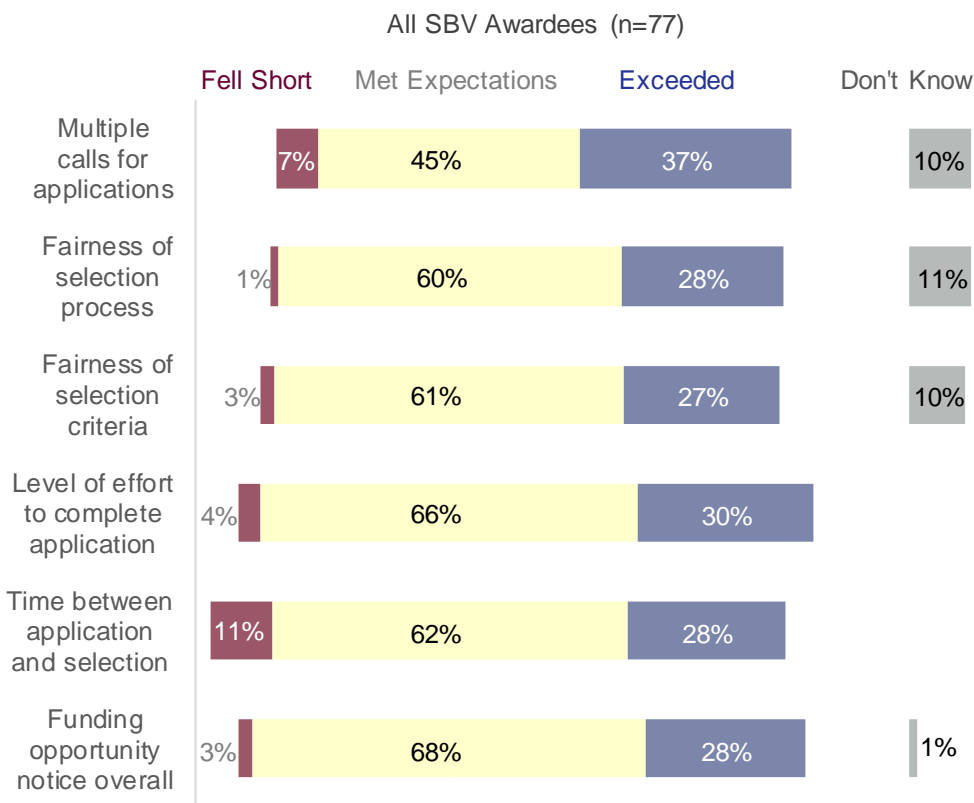
When asked to rate the overall ease of navigating the CAP on a five-point scale, where one is *not at all easy* and five is *very easy*, 78% of awardees said the SBV CAP was easy or very easy to navigate (mean a rating of 4.1 out of 5). Sixteen respondents gave the ease of navigating the SBV CAP a rating of three out of five, the lowest rating selected by any respondent for this metric.

⁴⁸ RIA, NMR, and Gretchen Jordan. 2016. Baseline and Process Evaluation of Small Business Vouchers Pilot. DOE/EE-1574. [SBV Baseline and Process Evaluation](#).

4.1.2 Application and Onboarding Experience

The application process is key to encouraging small businesses to collaborate with the Labs. The majority of SBV Awardees found that aspects of the application process and funding opportunity notice met or exceeded their expectations, including multiple calls for application, fairness of the selection process, fairness of the selection criteria, the level of effort to complete the application, and the time between application and selection, (Figure 10). Ninety-six percent of SBV awardees said the funding opportunity notice met or exceeded expectations overall. Although we did not ask non-participants to evaluate their experience in applying for SBV, many provided feedback about their experience in the recommendations section of the survey and/or over email directly to the evaluation team (Section 4.1.3)

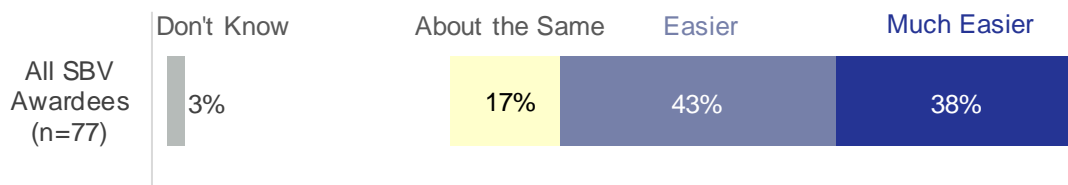
Figure 10: Extent to which Awardee Expectations Were Met by Aspects of Voucher Application Process and Funding Opportunity Notice



Awardees found the process of applying for SBV to be easier (43%) or much easier (38%) than applying for other federal awards.⁴⁹

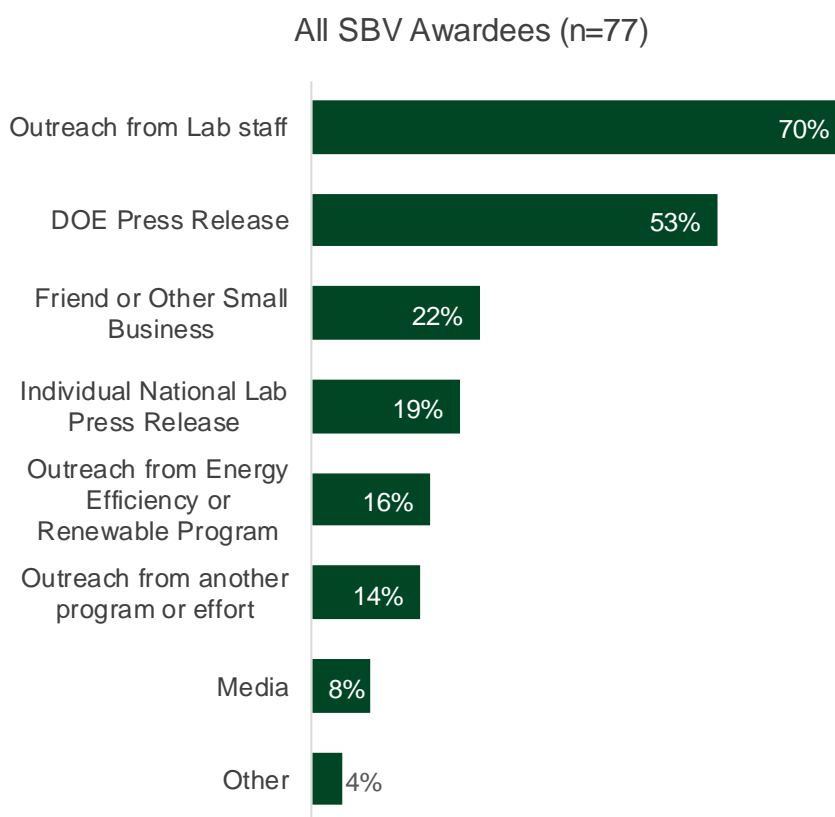
⁴⁹ The study did not seek comparable information from non-participants.

Figure 11: Awardee Opinion of the SBV Application Process Compared to Other Federal Awards or Federal Funding



SBV awardees most often said they learned about the SBV opportunity from outreach from Lab staff (70%), a press release from DOE (53%), or from a friend or another small business (22%) (Figure 12).

Figure 12: How Firm Learned About SBV
(multiple responses permitted)



4.1.3 Non-participant Feedback on the Application Process

Non-participants had a lot of constructive criticism to offer regarding the SBV application process. Five out of fifteen non-participants who provided suggestions said they would like more meaningful feedback on why a voucher was not awarded. Similarly, three said that the qualities of a successful application should be made clearer.

In addition to the comments provided in the survey and detailed in Table 11, the evaluators received several responses to the survey solicitation email from non-participants unsuccessful SBV applicants who were unhappy about the feedback they received about their application.

The inadequacy of feedback is a primary concern to non-participants and a cause of much dissatisfaction from those applicants, potentially damaging the reputation of the Labs as a resource for small businesses. The Labs might also view the work of providing more thorough feedback to non-participants as an opportunity to provide more awareness of other Lab programs or information about Lab expertise, general information about technology commercialization, and constructive feedback on the application in general.

In addition to the desire for improved application feedback, two non-participants suggested that the application process contain a phone or in-person interview. Overall, non-participants had eleven different suggestions on how to improve the SBV application process, listed in Table 11.

Table 11: Suggestions to Improve the SBV Program Offered by Non-participants
(multiple responses permitted)

Non-participants	
Positive Comments	<i>n</i>
<ul style="list-style-type: none"> • Great opportunity for small businesses (1) • Process is good overall (1) 	2
Constructive Criticism	<i>n</i>
<ul style="list-style-type: none"> • SBV Application process <ul style="list-style-type: none"> ○ Give more meaningful feedback on why grants are not awarded (5) ○ Make successful application expectations clear (3) ○ Increase period for asking technical questions (2) ○ Program application should include a phone or in-person interview (2) ○ Report the probability of receiving a grant early on (1) ○ Increase speed of application/approval process (1) ○ Allow for letters of support from the laboratories (1) ○ Process is biased against new technologies (1) ○ Make certain that reviewers have commercialization experience (1) ○ Provide applicants a template to fill out (1) ○ Make submission portal (1) • Other suggestions <ul style="list-style-type: none"> ○ Difficult to find the right fit between lab and business (1) ○ Increase funding available (1) 	15

4.2 SATISFACTION WITH CONTRACTING

DOE and lab staff involved in pilot design recognized that contracting with the lab for cooperative research or other assistance is time consuming and that this time burden is a substantial impediment to small businesses seeking lab services. DOE and the labs sought to mitigate this problem for the SBV pilot and developed short, standardized contracts for awardees. They developed two standard contracts, a short-form Cooperative Research and Development

Agreement (CRADA; the contracting vehicle most commonly used for lab-private sector collaboration),⁵⁰ and a Technical Assistance Pilot Agreement (TAPA; unique to the SBV pilot).⁵¹

The study sought to assess awardee’s satisfaction with SBV contracting processes. As context for this inquiry, the study first asked awardees to specify the type of SBV agreement they had with the labs and asked the five non-participants that had previously worked with the labs what type of agreement had governed that work (Table 12).

Table 12: Type of Contract or Agreement with Lab*

Type of Contract/Agreement	All Awardees (n = 77)	Non-participants (n = 5)
CRADA	78%	80%
TAPA	12%	0%
Both	1%	0%
Don’t know/refused	9%	20%
Total	100%	100%

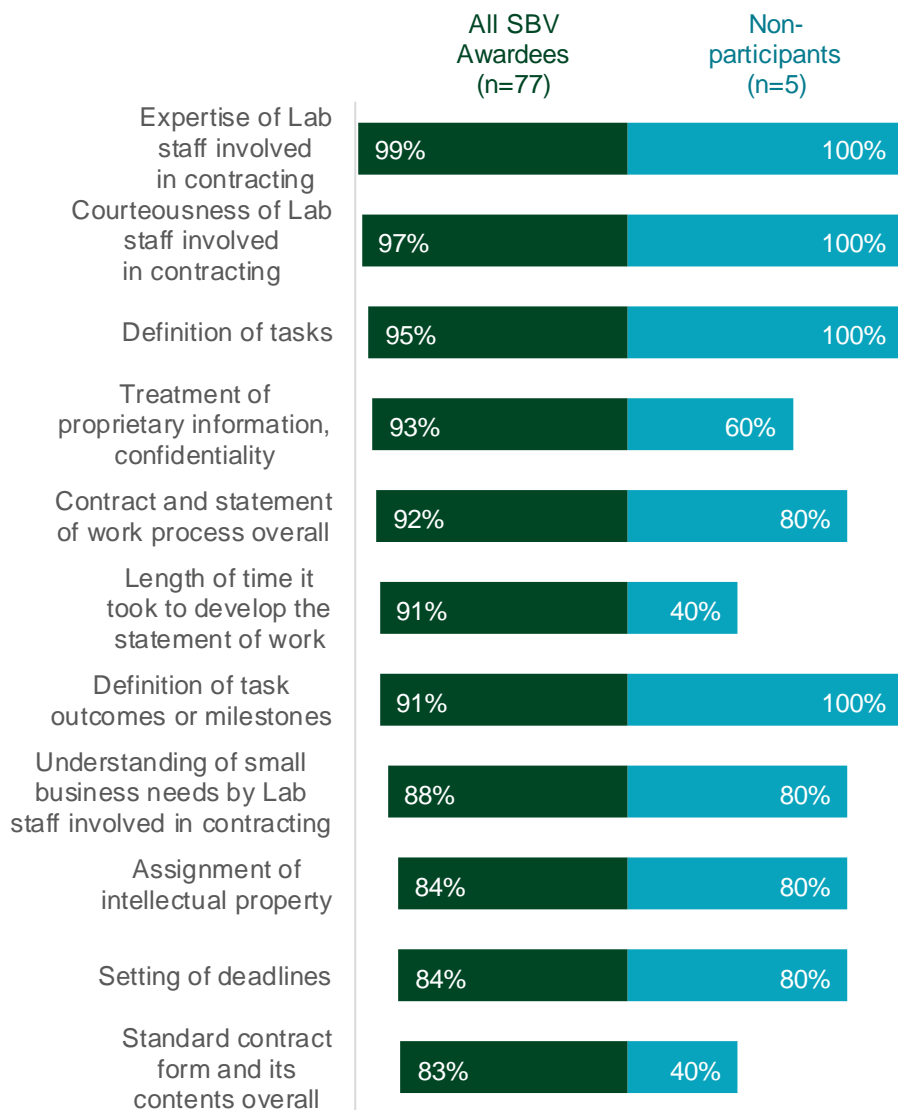
*Participants are describing their SBV contracts; non-participants are describing prior contracts they had with the labs. TAPAs are unique to the SBV pilot.

Awardees’ expectations about the SBV contracting process were almost all met or exceeded on a range of elements associated with settling the terms of the assistance and the statement of work (Figure 13). One element to note is that 91% of awardees’ expectations were met or exceeded with the amount of time it took to develop the statement of work, compared to 40% (2 of 5) of non-participants reporting on non-SBV contracting experiences.

⁵⁰ The SBV CRADA is a standard ten-page agreement developed by EERE (in collaboration with relevant DOE and lab parties) 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.

⁵¹ The SBV TAPA is a standard three-page agreement developed by EERE (in collaboration with relevant DOE and lab parties) 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.

Figure 13: Extent to which Expectations Were Met for Contracting (SBV and Non-SBV Contracts with Labs)

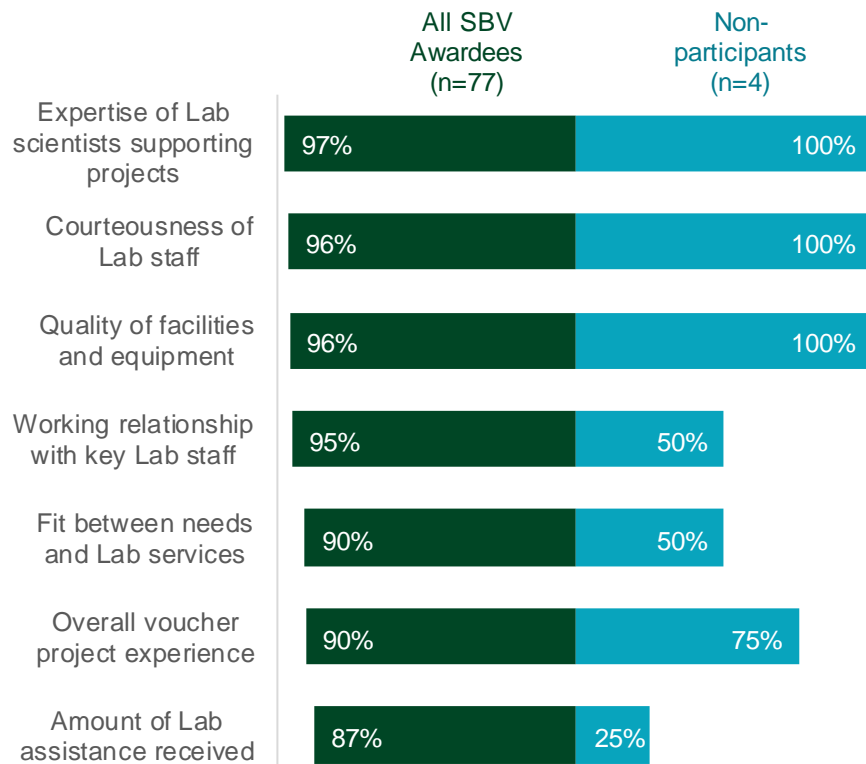


*Percent who said that their expectations were met or exceeded.

4.3 SATISFACTION WITH QUALITY OF WORK PROVIDED BY LABS

Awardees’ expectations about the quality of the work, facilities, staff expertise, and other elements of conducting the SBV-related work with the labs were almost all met or exceeded on a range of elements (Figure 14). The small number of non-participants that had non-SBV lab relationships were considerably less satisfied than awardees were with their working relationship with key lab staff, fit, and amount of assistance.

Figure 14: Extent to which Expectations Were Met for Work with the Labs (SBV and Non-SBV Contracts with Labs)

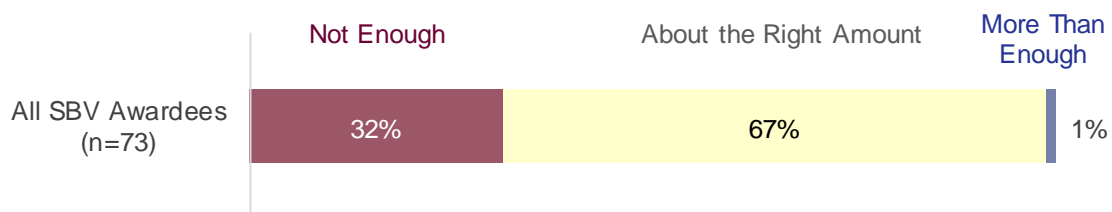


*Percent who said that their expectations were met or exceeded.

4.4 SATISFACTION WITH FUNDING OF SBV VOUCHER

More than two-thirds (68%) of awardees reported that the SBV funding was the right amount or more than enough for their research needs (Figure 15).

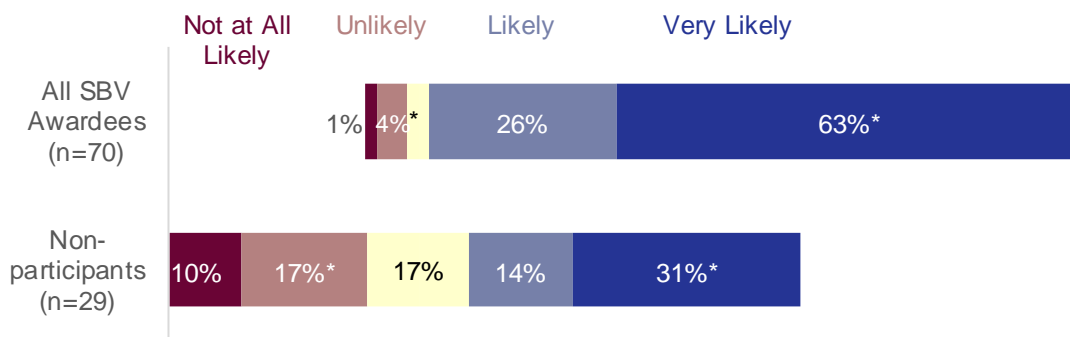
Figure 15: Assessment of SBV Funding



4.5 PROPORTION INTERESTED IN REPEATED WORK WITH LABS

Sixty-three percent of all SBV awardees reported being very likely to work with the Labs again, compared to 31% of non-participants (a statistically significant difference) (Figure 16).⁵² This finding suggests that the experience made a positive impression on most awardees. A few awardees (5%) reported they were unlikely to work with the Labs again. Three of these four participants reported that they would not recommend SBV to their colleagues, citing delayed funds and/or difficulty working with lab management.

Figure 16: Likelihood that You Will Work with the Labs Again



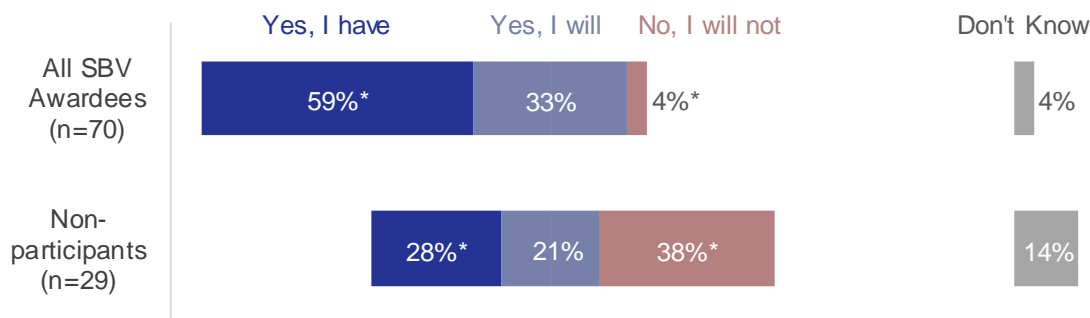
*Statistically significantly different at the 90% confidence level.

4.6 PROPORTION RECOMMENDING TO COLLEAGUES

Ninety-two percent of SBV awardees said they had recommended or will recommend that their colleagues work with the Labs (Figure 17). Awardees have made recommendations to an average of 4.6 colleagues or plan to recommend to an average of 4.3 colleagues (Table 13). Three SBV awardees said they would not recommend that their colleagues work with the labs – these individuals went on to describe a difficult experience they had working with the Labs. Table 13 reports the estimated number of colleagues SBV awardees said they had recommended or will recommend work with the Labs; note that only a subset of respondents estimated the number of colleagues.

⁵² Respondents were asked to rate their likelihood on a five-point scale, where one is “not at all likely” and five is “very likely.”

Figure 17: Respondent Recommendations to Colleagues or Other Small Businesses that They Work with the Labs



* Statistically significantly different at the 90% confidence level.

Table 13: Respondent Recommendations to Colleagues or Other Small Businesses that They Work with the Labs

	Awardees			Non-participants		
	Range	Mean	N	Range	Mean	n
Number of colleagues you made this recommendation to	1-20	4.6	11	1-10	4.0	5
Number of colleagues you anticipate making this recommendation to	2-10	4.3	5	2-5	2.7	6

Ten non-participants articulated why they will not or might not recommend SBV to their colleagues. Many had negative comments about the application process or the feedback received, perhaps due to not being selected. Three said that the feedback received explaining why their application was not accepted was insufficient, three said the resources required to apply to the program are too substantial, and three said the chances of getting an SBV award are too small to justify the expense of preparing an application (see Section 4.1.3 for more discussion of the non-participants’ perception of inadequate feedback from the Labs).

4.7 AWARDEE FEEDBACK ON ENGAGEMENT EXPERIENCE

Eight awardees, in response to an open-ended request for recommendations, expressed appreciation for the SBV pilot, most commonly saying they were impressed with the results generated by the lab (3) and were very satisfied with the process and outcome of the program (3). The constructive criticism offered by SBV awardees centered around six main themes: managing expectations, intellectual property rights, budget concerns, timing concerns, a desire for more follow-up and continued opportunities, and a desire for a simplified process (Table 14).

Table 14: Suggestions to Improve the SBV Program Offered by Awardees
(multiple responses permitted)

Awardees	
Positive Comments	<i>n</i>
<ul style="list-style-type: none"> • Impressed with results generated by the lab (3) • Very satisfied with process and outcome of program (3) • Gained access to state of the art equipment (2) • The program is managed well; wait/queue times are shorter than expected (1) • Collaboration with the lab had a positive impact on customer’s engagement (1) • Commercialization was expedited due to the program (1) • Supported the development of a quarterly newsletter highlighting advances accomplished in the last quarter (1) • May encourage other participants (1) 	8
Constructive Criticism	<i>n</i>
<ul style="list-style-type: none"> • Manage program expectations (2) <ul style="list-style-type: none"> ○ For project proposals, expect incremental change, not transformational change (1) ○ This survey asked about IPOs, substantial sales, etc., but that's not very realistic for the time and money involved in the SBV program (1) • Intellectual Property Rights (4) <ul style="list-style-type: none"> ○ Intellectual property rights should be made explicit before work begins and should be more favorable to the small business client (4) • Budget concerns (14) <ul style="list-style-type: none"> ○ Increase value of award (7) <ul style="list-style-type: none"> ▪ A larger award would speed up the pace of commercialization (2) ▪ Limit was insufficient to take the project to pilot scale; funding limit dissuaded company from applying for another SBV award for other projects (1) ○ Labs should contribute more towards the cost of the work than the small business partner (ratio of matching funds should be more in favor of small business, including administrative costs) (2) ○ Money should be allocated for travel so company and lab can physically work together (1) ○ Additional costs associated with working with the Lab should be disclosed in advance to help awardees budget for the project (2) ○ There should be closer agreement between projected cost and dollars spent (1) ○ Please publish SBV budget allocation to each DOE subprogram; some labs had expended their apportionment and could not accept proposals (1) • Improve response time (9) <ul style="list-style-type: none"> ○ Timeline between award selection and resource delivery should be clearer and expedited (6) ○ The process for receiving funds needs to be improved; currently too slow (1) ○ Labs need to operate more quickly; disparity between laboratory pace and small business pace makes collaboration difficult (2) 	43

<ul style="list-style-type: none"> ○ Provide an explicit mechanism to support delays (1) • More follow-up and opportunities for a continued relationship with the labs (3) <ul style="list-style-type: none"> ○ There should be an opportunity for SBV awardees to receive follow-on funding to ensure projects have the resources they need to take their technology to the next stage (3) • Improve process (7) <ul style="list-style-type: none"> ○ Provide more information online for businesses to review about the specific capabilities of the labs, as many business owners are not familiar with the labs, and business owner expectations may not match reality (2) ○ Allow businesses to partner with multiple labs for the duration of SBV (2) ○ Simplify language in initial documentation; no <i>government speak</i> (1) ○ Make the contracting processes easier and more informal (1) ○ The SBV Program should involve more direct contact (1) 	
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Section 5 Findings: Commercialization Assistance

5.1 ADVANCEMENT OF TECHNOLOGY READINESS LEVELS

Advancement in technology readiness level is the key outcome of the SBV pilot, as discussed in [Section 2](#). We asked awardees and non-participants to assess, on a nine-stage scale, the development of their technology at the time of the survey⁵³ and to assess the stage retrospectively at the time they applied to or received the SBV award.^{54,55} Note that the TRL data reported in this section are from the evaluation survey, whereas the TRL reported in [Section 3.2.1](#) are the RFA-calculated TRL values.

According to their self-reports in the evaluation survey, awardees started with a lower average TRL than non-participants (3.6 compared to 4.5; a statistically significant difference) but demonstrated more progress over time in the development of their technologies ([Table 15](#)). While 72% of awardees described their technologies at the time of award as ranging up to proof of application (levels 1 to 4), 42% reported these same developmental levels at the time of the survey, a statistically significant difference. There were no statistically significant differences in the percentage of awardees and non-participants at the commercialization stages (levels 7 to 9), either at the time of the award or the time of the survey. These patterns are consistent across the individual rounds of awardees (see [Appendix C](#)).

As shown in [Table 15](#), we received an elevated non-response rate to the question of development at the time of the survey. Most item non-respondents reported early stage development (levels 1 to 4); this was especially the case for non-participants. To explore this issue further, we assumed that item non-respondents had no change in stage of development from time of award to time of survey, under the hypothesis that the respondent was experiencing survey fatigue and decided not to report the same information twice. The pattern of responses remained unchanged, although the pattern a bit more pronounced, with early-stage technologies among awardees, declining from 72% at time of award to 42% at time of survey. And for non-participants, early-stage technologies

⁵³ We surveyed Round 1 awardees 21 months after the SBV award announcement, Round 2 awardees and non-participants 9 months after the award announcement, and Round 3 awardees seven months after award announcement.

⁵⁴ The SBV pilot assigned, during proposal review, TRL scores to Round 1 and 2 applicants based on responses to a multi-question battery in the RFA related to the stage of development of the applicant's technology. (See [Section 3.2.1](#).) The application-calculated TRLs were moderately correlated to the self-assessed pre-SBV TRL scores for Round 2 awardees (Pearson correlation of 0.38); non-participant scores had a stronger correlation to the application-calculated TRLs (Pearson correlation of 0.56). One might hypothesize that experience with SBV leads a small business to more rigorously assess the readiness of its technology. The current study did not assess this hypothesis.

⁵⁵ For ease of web-survey administration, the question regarding technology advancement paraphrased DOE's TRL descriptions for brevity and simplicity. See [Appendix A](#) for a comparison of the stages of commercialization used in this survey and TRLs. DOE has developed a "systematic, metric-based" approach to assessing TRL levels, a methodology that was outside the scope of this evaluation. See *Technology Readiness Assessment (TRA)/Technology Maturation Plan (TMP) Process Guide*, U.S. Department of Energy, March 2008.

among non-participants held relatively constant at 52% at the time of award and 45% at the time of survey.⁵⁶

Table 15: Stage of Development at Time of SBV Award and at Time of Survey

Stage of Development/ Commercialization	Awardees		Non-participants	
	Time of SBV Award* (n = 72)	Time of Survey (n = 31)	Time of SBV Award* (n = 38)	Time of Survey (n = 22)
Conceptualization and proof of concept (1 to 4)	72%**	42%	52%**	45%
Validation stages (5 & 6)	19%	39%	35%	36%
Commercialization stages (7 to 9)	8%	14%	13%	18%
Average	3.6**	4.9	4.5*	4.9

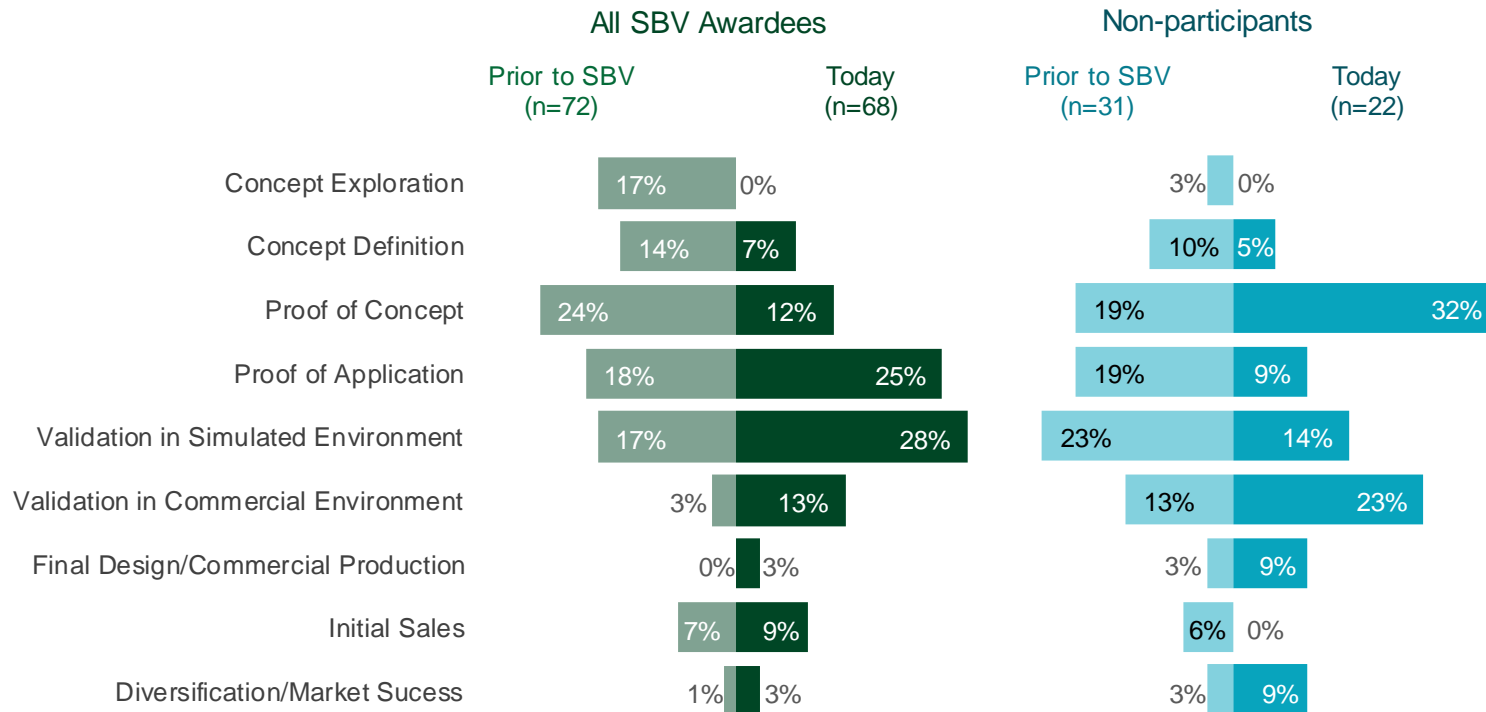
*TRL at time of award was reported by survey respondents. For many respondents, their survey response differed from the TRL calculated by the SBV-pilot (calculated from responses to a series of questions in the application [RFA]).

** Statistically significantly different at the 90% confidence level.

Figure 18 provides a more detailed examination of change in stage of development by illustrating responses at each of the nine developmental stages.

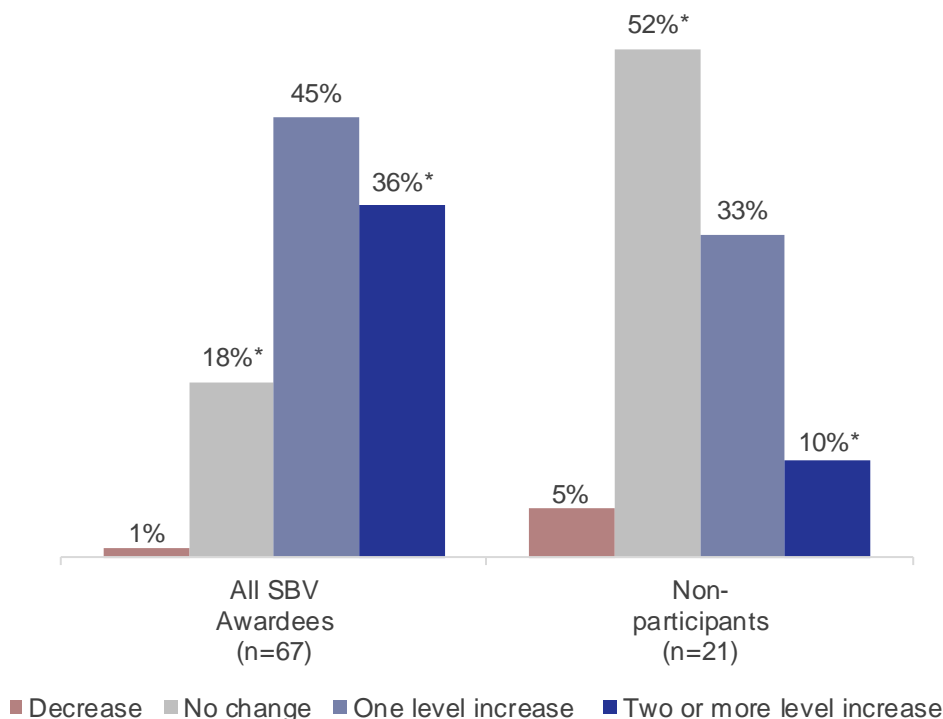
⁵⁶ For both awardees and non-participants, the percentage in late-stage development remained unchanged with the imputation of item non-responses; the proportion of mid-stage respondents fell commensurate with the increase in early-stage.

Figure 18: Awardee Stage of Development Before and After SBV Award



Four out of five (81%) awardee respondents reported their technology had advanced at least one stage of development, compared to 43% of non-participants (a statistically significant difference). About half (52%) of non-participants reported that they were at the same levels of development at the start and end of the study period (Figure 19). As a group, the stage of development among awardee respondents increased by an average of approximately 1.3 levels from SBV award to time of survey,⁵⁷ compared to an average of 0.5 levels among non-participants (a statistically significant difference).⁵⁸

Figure 19: Change in Stage of Development



* Statistically significantly different at the 90% confidence level.

The higher rate of change for the awardees may reflect the fact that, as a group, a higher percentage started in the conceptualization and proof of concept stages. However, at time of award, the awardees – per the information reported in the RFAs – had slightly higher stages of development

⁵⁷ There is no *typical* progression of TRL over time. Among entrepreneurs, TRL progression is highly dependent on such factors as (1) the complexity of the innovation (software may reach commercialization within a year or two, while some innovations can take more than a decade), (2) the characteristics of the market (how market-disruptive is the technology? Are there established supply chains? What is the competitive value of the innovation?), and (3) the interest of the initial target market in the innovation (how many change of direction [*pivots*] are needed? How substantial are the changes needed?). See Section 2.1.

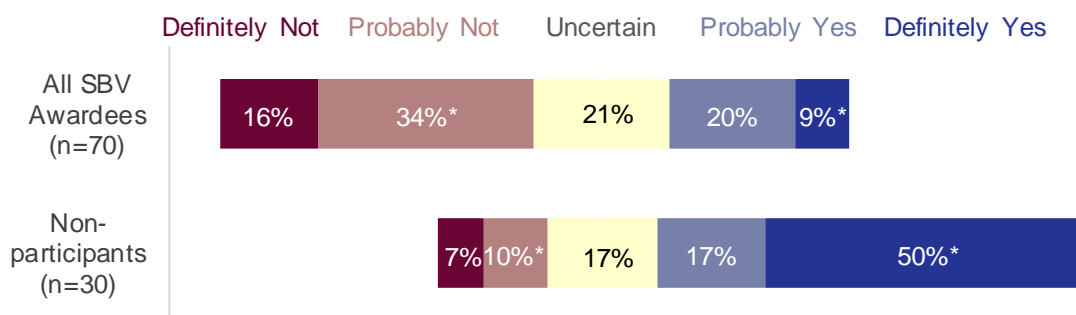
⁵⁸ Note the sample sizes. This analysis describes respondents that provided both time of award and time of survey responses to technology development. If we were to impute item non-responses assuming no change in stage of development, the pattern that awardee change outpaces non-participant change would be more pronounced.

than the non-participants (as discussed in [Section 3.2.1](#)). Although awardees’ survey answers suggest a lower initial developmental stage than non-participants, it may be the case that experience with SBV influences a small business’s sense of technology readiness and thus influenced survey responses. Under this hypothesis, awardees would be more accurate in their reporting and non-participants more inflated in their reporting of technology development. Should that be the case – a conjecture the study is unable to assess – the survey responses underestimate the differential between awardees and non-participants in technology development during the study period.

5.1.1 Project Status in the Absence of SBV Award

Respondents rated the likelihood that they would have undertaken the same project in the absence of their SBV award or applying for an SBV award. One-half (50%) of SBV awardees *probably* or *definitely* would not have undertaken the project in the absence of the award, while 17% of non-participants *probably* or *definitely* would not have undertaken the project in the absence of applying for SBV, a statistically significant difference ([Figure 20](#)).

Figure 20: Project Status in the Absence of the SBV Award or Applying for the SBV Award



*Statistically significantly different at the 90% confidence level.

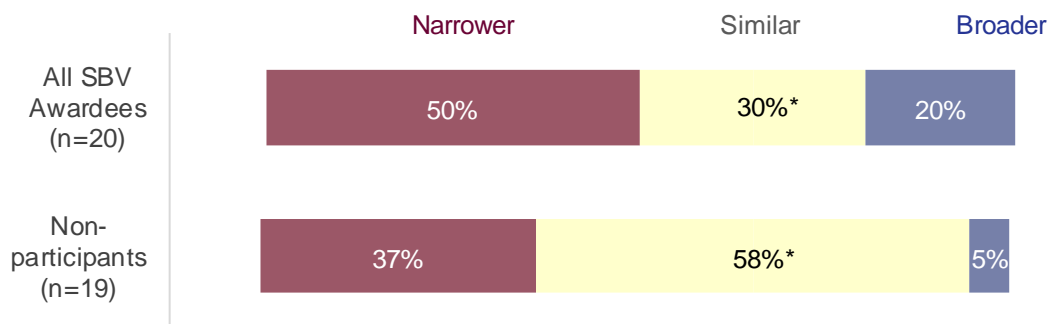
We can hypothesize, although not confirm, conditions that would explain these findings. As noted in [Section 3.2.6](#), prior to the SBV opportunity, all small businesses had been engaged in technology development and, in most cases, they continued that development after the award announcement. But while the awardees are engaging in collaborative research with the labs, the non-participants must get on with the business of readying their technologies for sale without conducting the proposed collaborative research and obtaining unique lab services. SBV awardees thus differ from non-participants with respect to project status in the absence of an award due to one or more of the following known and hypothesized conditions:

- Awardees are conducting their proposed research, whereas non-participants are conducting a variant of that research possible in the absence of a unique lab contribution (a known difference)
- Awardees, having embarked on their proposed projects, have a more realistic assessment of their ability to move forward without the SBV award (a hypothesized difference)
- Awardees, having embarked on their proposed projects, have a more realistic assessment of their technologies’ readiness (a difference hypothesized in the prior section), which in turn influences their assessment of their ability to progress

- Awardees were more in need of vouchers in the opinion of the pilot team (a hypothesized difference); however, awardees and non-participants did not differ statistically significantly in their RFA-reported data in terms of stage of technology development (and specifically the late-stage development of sales) and prior commercialization experience (Sections 3.2.1 and 3.2.3).

One-half (50%) of the awardees – versus 37% of non-participants – who said they would *probably* or *definitely* have undertaken the project in the absence of the SBV award, said their project would have been narrower in scope (Figure 21). Just under one-third (30%) of awardees who would have undertaken the project in the absence of the award said it would have been similar in scope, and one-fifth (20%) said it would have been broader in scope. These findings are consistent with an interpretation that awardees have, due to their SBV experiences, a more realistic understanding of the work entailed in advancing their technologies, although this explanation remains a hypothesis.

Figure 21: Estimated Scope of Project if Undertaken in Absence of SBV Award or Applying for SBV Award

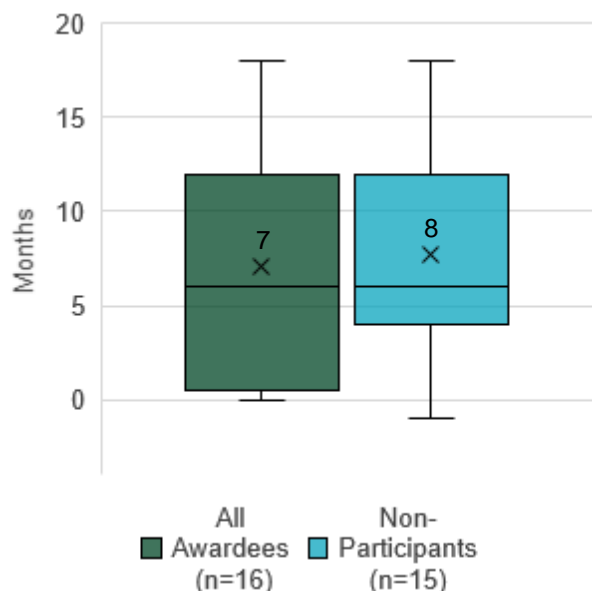


*Statistically significantly different at the 90% confidence level.

5.1.2 Timing of Project in the Absence of SBV Award

Awardees and non-participants who *probably* or *definitely* would have undertaken the project in the absence of the SBV award estimated that the start of their project would have been delayed, on average, by a similar amount of time: seven months for awardees and eight months for non-participants (Figure 22). The minimum estimated delay among awardees was zero months, while the minimum among non-participants was negative one months, indicating this respondent felt the project may have been expedited one month in the absence of applying for SBV. The median estimated delay (6 months), maximum (18 months), and mode (12 months) were the same for both awardees and non-participants.

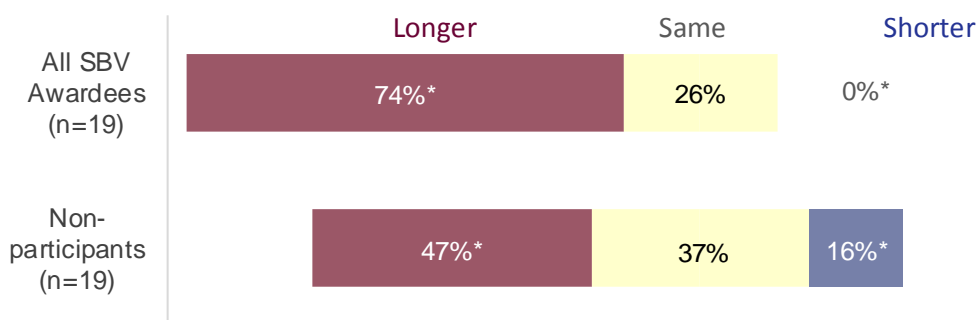
Figure 22: Estimated Delay if Undertaken in Absence of SBV Award or Applying for SBV Award



*X represents the mean.

Nearly three-quarters (74%) of awardees who *probably* or *definitely* would have undertaken the project in the absence of the award said the duration or time to completion of the project would have been longer (Figure 23). This suggests that even awardees who were relatively confident that their project would have proceeded without the award felt that the SBV award helped give the process a boost. In comparison, less than one-half (47%) of non-participants who would have undertaken the project in the absence of applying for the award said the duration or time to completion of the project would have been longer, a statistically significant difference. Sixteen percent of non-participants who would have undertaken the project in the absence of applying for the award said the duration would have been shorter. These findings are consistent with an interpretation that SBV awardees are characterizing their projects and/or their level of technology readiness differently from the non-participants.

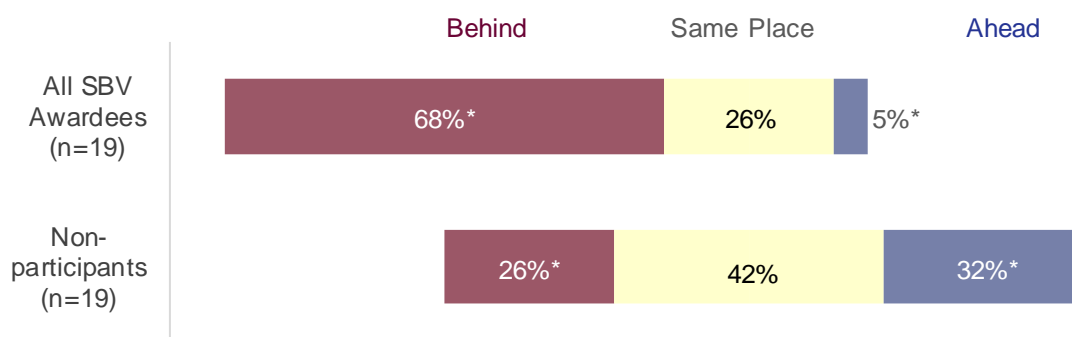
Figure 23: Estimated Time to Completion of Project if Undertaken in Absence of SBV Award or Applying for SBV Award



*Statistically significantly different at the 90% confidence level.

Over two-thirds (68%) of awardees who *probably* or *definitely* would have undertaken the project in the absence of the SBV award estimated that the project would be behind in achieving similar goals and milestones compared to 26% of non-participants, a statistically significant difference (Figure 24). Nearly one-third (32%) of non-participants and 5% of awardees estimated that the project would be ahead (a statistically significant difference). We hypothesize that non-participants who reported that the project duration would have been shorter or the project would have been ahead in the absence of applying for the award felt that applying for the award took time and resources away from achieving goals and milestones. In the cases where non-participants reported that their project would have been behind in achieving similar milestones, or the project duration would have been longer, it may be that non-participants found some value in preparing a voucher RFA even though they did not ultimately receive an award.

Figure 24: Estimated Progress if Project Undertaken in Absence of SBV Award or Applying for SBV Award



*Statistically significantly different at the 90% confidence level.

5.2 AMOUNT OF FOLLOW-ON FUNDING OBTAINED

In this section, we report on follow-on funding of SBV-related technologies, a secondary anticipated outcome of SBV. As noted in Section 3.2.6, more than two-thirds (67%) of awardees had not completed their SBV funded research at the time of the survey, whereas 35% of non-participants were still working on their research (Figure 8). We caution that, due to lack of project completion, it may be premature to draw conclusions about SBV’s effectiveness on increasing the likelihood and quantity of follow-on funding.

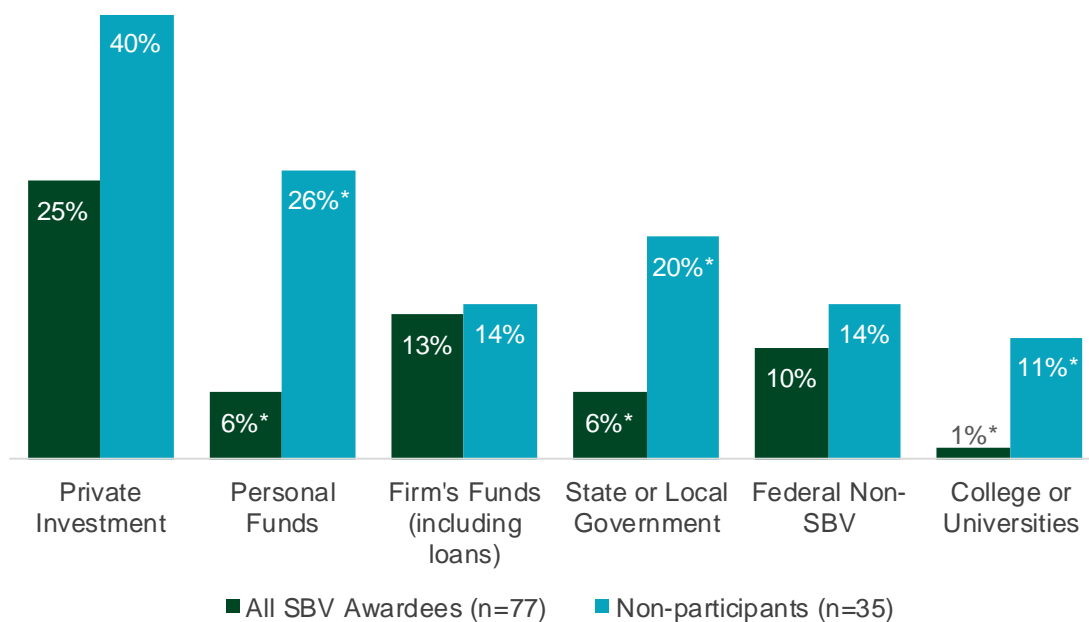
The percentage of SBV awardees who reported receiving or investing additional developmental funding in their SBV-supported technology was less than that of non-participants, although the finding lacks statistical significance: 47% of SBV awardees received or invested additional developmental funding in their SBV project subsequent to the SBV award, compared to 60% of non-participants (Figure 25). The team examined follow-on funding by round and technology type (Appendix C) and found no differences in rates of follow-on funding between Round 1 and 3 awardees and non-participants. However, Round 2 awardees had statistically significantly lower rates of follow-on funding. There were no differences by technology type for awardees or non-participants.

Figure 25: Received or Invested Additional Development Funding



Figure 26 displays the percentage of respondents who reported receiving or investing additional developmental funding by funding source. The most common form of additional funding for both awardees and non-participants was private investment, including U.S. venture capital, foreign investments, and other private equity (such as angel funding). A statistically significantly larger proportion of non-participants than awardees reported investing personal funds or receiving funding from state/local governments or colleges/universities.

Figure 26: Received or Invested Additional Development Funding by Funding Source



*Statistically significantly different at the 90% confidence level.

Thirty-two awardees and eighteen non-participants who reported receiving additional funding indicated the amount of funding by selecting one of the following ranges:

- \$1 to \$99,999
- \$100,000 to \$499,999
- \$500,000 to \$999,999
- \$1,000,000 to \$4,999,999

- \$5,000,000 to \$9,999,999
- \$10,000,000 or more

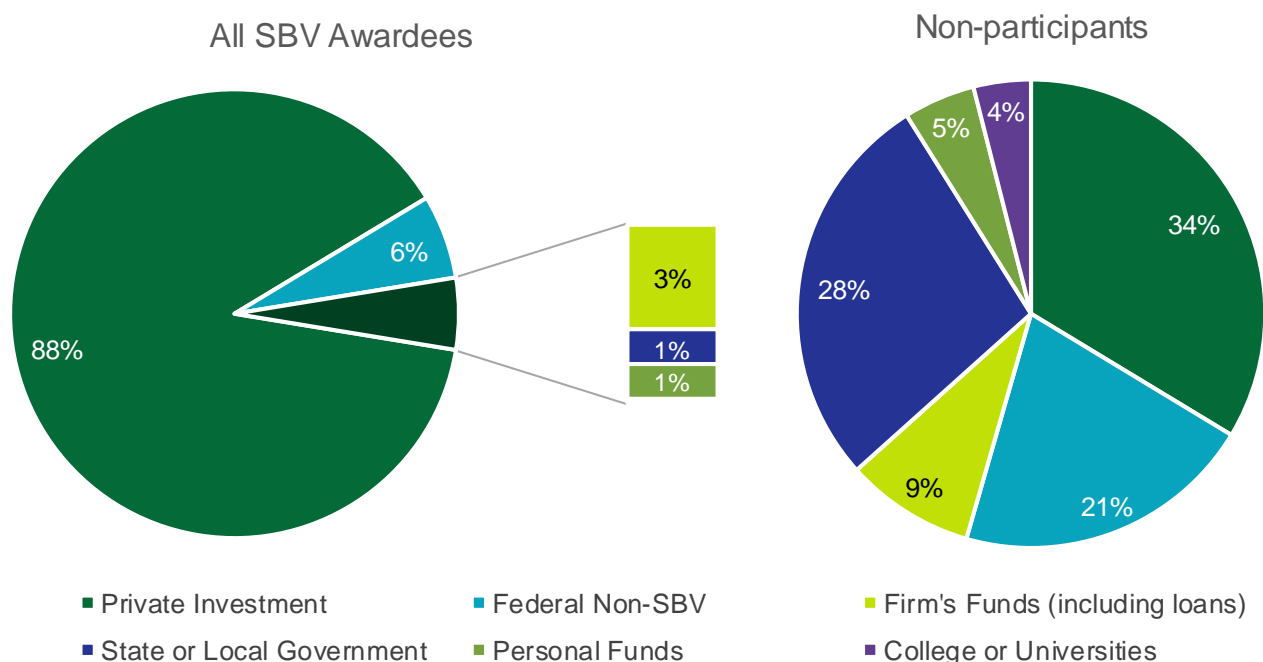
Because the funding amounts were reported as ranges, we developed a lower and upper estimate of funding received. For the lower estimate, we used the lowest value in each range, with exceptions for the first range of under \$100,000, to which we assigned a conservative value of \$5,000, and the largest range of \$10,000,000 and more, to which we assigned a value of \$10,000,000. The higher values in our reported ranges are based on the midpoint of the range presented for each category, with the exception of the largest category, to which we again assigned a value of \$10,000,000. For example, the value of \$50,000 is used if the respondent selected the first range of under \$100,000. [Table 16](#) displays these estimated additional funding ranges by source and overall. The sum of estimated additional funding across awardees who reported receiving additional funding ranges from \$19 to \$40 million, with an average of \$585,000 to \$1.2 million per awardee. In comparison, the sum of estimated additional funding across non-participants who reported receiving additional funding ranges from \$24 to \$42 million, with an average of \$1.3 to \$2.3 million per non-participant. For more details on the distribution of funding awards, see [Appendix C](#). The lower average for awardees may be due to a high count of the smallest category of under \$100,000.

Table 16: Estimated Additional Funding (\$ thousands)

Funding Source	SBV Awardees (n = 32)	Non-participants (n = 18)
Private Investment	\$16,930 – 35,250	\$4,620 – 14,000
Federal Non-SBV Funds	\$1,315 – 2,550	\$5,705 – 8,900
Firm's Funds (including loans)	\$335 – 1,250	\$1,210 – 3,700
State or Local Government	\$120 – 500	\$10,715 – 11,500
Personal Funds	\$25 – 250	\$825 – 1,900
College or Universities	\$5 – 50	\$1,010 – 1,600
Total Reported Funding	\$18,730 – 39,850	\$24,085 – 41,600
Average Funding	\$585 – 1,245	\$1,338 – 2,311

Using the upper range of our estimate of funding received, we estimated the distribution of additional funding by source for awardees and non-participants. Although private investment accounts for the largest share of additional funding for both awardees (88%) and non-participants (34%), non-participant additional funding is more evenly distributed among other funding sources, such as federal non-SBV funds, state/local government funds, firm’s funds, personal funds, and colleges/universities.

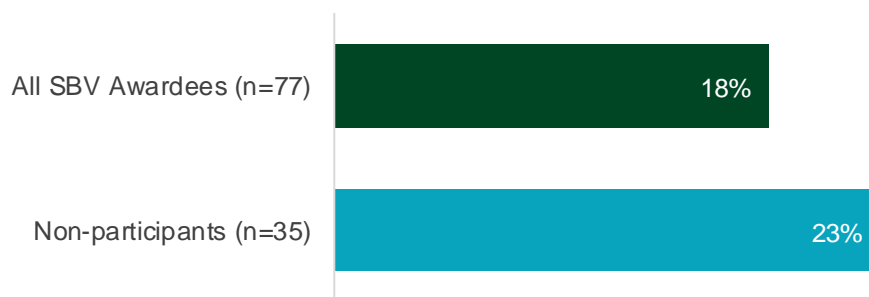
Figure 27: Distribution of Total Additional Funding by Source



5.3 PROPORTION WITH TECHNOLOGIES COMMERCIALY LAUNCHED (A SALE)

For DOE, technology commercialization equates to technology sales; yet technology sales is an anticipated outcome of the SBV pilot. Since applying to SBV or SBV award, slightly fewer SBV awardees (18%) reported sales of products, services, processes, and other sales of their SBV-related technology (such as rights to technology, licensing) than non-participants (23%), a difference that is not statistically significant (See Figure 28). However, of those reporting sales in the survey, non-participants were more likely than awardees to also have reported sales in their RFAs (50% to 29%). Therefore, some caution is warranted in interpreting the sales data as respondents may have been thinking of their pre-SBV sales when responding to the survey.

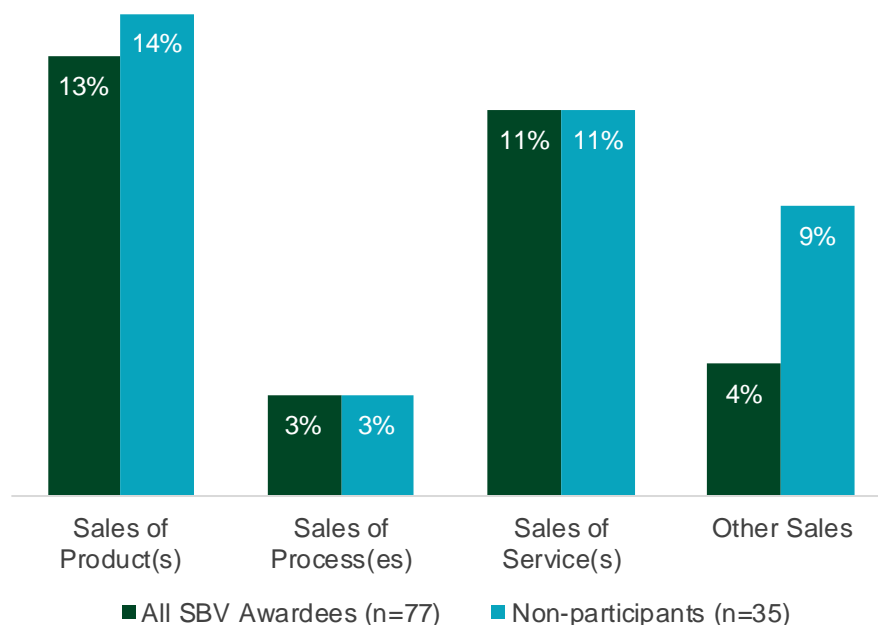
Figure 28: Sales Since Award Announcement or Since Applying to SBV



5.3.1 Details on Sales Since Award Announcement or Since Applying to SBV

For awardees and non-participants who reported sales, the most common type of sale reported by both awardees and non-participants was of products (12% and 14%, respectively), followed by services (10% and 11%, respectively). Nine percent of non-participants and 4% of awardees reported other sales, such as rights to technology and licensing. Three percent of awardees and 3% of non-participants reported sales of processes.

Figure 29: Sales by Type



The awardees and non-participants who reported making a sale of any kind were asked to state the date of first sale and the approximate amount of total sales.⁵⁹ The awardees reported first sales ranging from April 2017 to June 2018, while non-participants reported first sales ranging from August 2016 to March 2017 (Figure 30).⁶⁰ The June 2018 sale could be an agreement with a planned product/service delivery date in June 2018.

⁵⁹ Two awardees and one non-participant who reported making sales did not disclose the approximate value of those sales.

⁶⁰ We excluded one awardee response and two non-participant responses that pre-dated the award announcements.

Figure 30: Date of First Sale

Round 1	Round 2	Round 3	Non-participants
• Apr 2017	• Nov 2016	• Oct 2017	• Aug 2016
• Jun 2017	• Apr 2017	• Jun 2018	• Sep 2016
• Dec 2017			• Jan 2017
			• Mar 2017

Seven awardees and six non-participants who reported making sales indicated the amount of sales by selecting one of the following ranges:

- \$1 to \$99,999
- \$100,000 to \$499,999
- \$500,000 to \$999,999
- \$1,000,000 to \$4,999,999
- \$5,000,000 to \$9,999,999
- \$10,000,000 or more

We developed lower and upper estimates for the sales amounts in the same way as we did for the additional development funding amounts. For the lower estimate, we used the lowest value in each range (with exceptions for the first and largest ranges), while the upper estimates are based on the range midpoints (with the exception of the largest category). Table 17 displays these estimated sales ranges by type of sale and overall. The sum of estimated sales across awardees who reported making sales ranges from \$160,000 to \$900,000, with an average value of \$26,000 to \$150,000 per respondent. In comparison, the sum of estimated sales across non-participants who reported making sales ranges from \$430,000 to \$1.5 million,⁶¹ with an average value of \$61,000 to \$214,000 per respondent.

Table 17: Estimated Sales (\$ thousands)

Sales	SBV Awardees (n = 7)	Non-participants (n = 6)
Products, Processes, & Services	\$130 – 600	\$220 – 800
Other Sales*	\$30 – 300	\$210 – 700
Total Reported Sales	\$160 – 900	\$430 – 1,500
Average Sales	\$26 – 150	\$61 – 214

*Includes rights to technology, licensing, sale of spin off company, etc.

⁶¹ The maximum sales amount range selected by all awardees and nearly all non-participants was \$100,000 to \$499,999. We excluded one non-participant sales outlier of \$1,000,000 to \$4,999,999. Including this response increases the non-participant total reported sales range to \$1,430,000 to \$4,500,000, and the average sales per non-participant respondent to \$204,000 to \$643,000.

One key factor driving the differences between awardees and non-participants in reported sales may be the fact that 90% of awardees either have not completed their SBV-funded research or are continuing with technology development (67% and 23%, respectively) compared to 52% of non-participants (35% of whom had not completed their research and 16% of whom were continuing with technology development), as reported in [Section 3.2.6](#).

The team also examined the relationship between several other factors and sales. For example, self-funding may be a factor in the difference in sales as non-participants were more likely to state they had self or firm funding (32%) than awardees (15%), and half of non-participants with self or firm funding reported sales (though a smaller percentage of awardees with self or firm-funding, 29%, reported sales). Intention to go forward with SBV-related technology in the absence of SBV funding may also be a factor. Both awardees and non-participants who reported they likely would have gone through with the project in the absence of SBV were more likely to report having sales (33%) than those who were unlikely to go forward without SBV (14%), and a higher percentage of non-participants (67%) reported they likely would have undertaken the project in the absence of SBV than awardees (29%).

Other factors, such as size of firm and TRL-level at the time of the application, do not appear to be associated with sales.⁶²

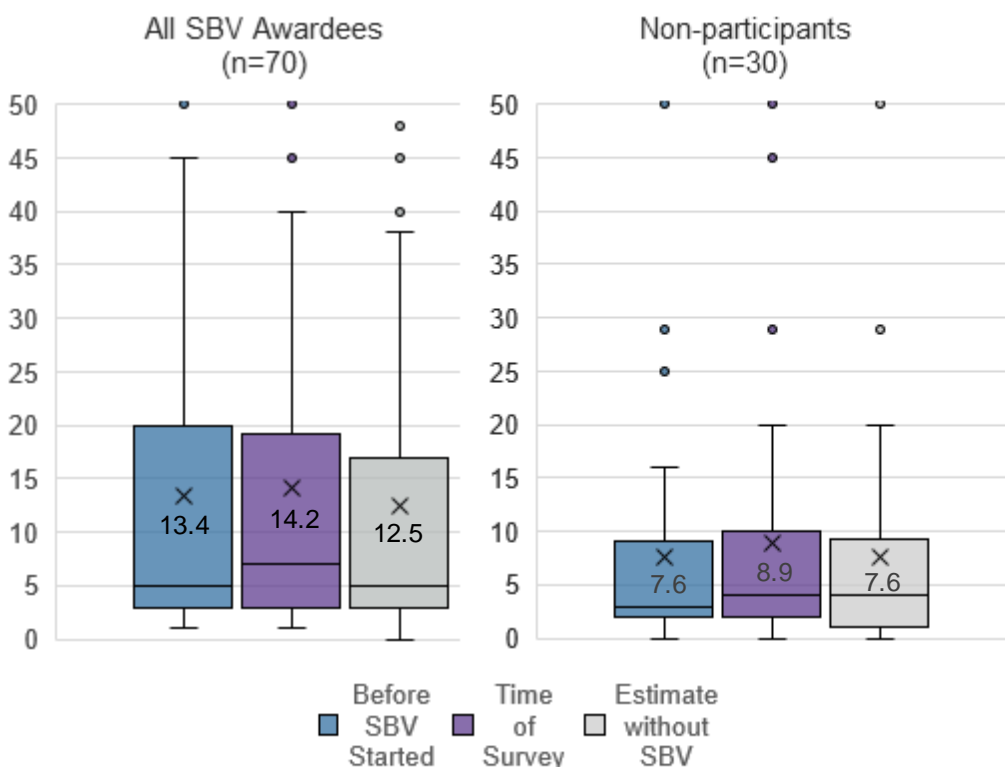
5.4 EMPLOYMENT EFFECTS FROM TECHNOLOGY

Employment effects are another anticipated later outcome of the SBV pilot. [Figure 31](#) contains box and whisker plots summarizing the distribution of three different estimates of the number of people employed at respondents' firms (1) just before the SBV Lab contract started, (2) at the time of the survey, and (3) respondents' estimates of the number of people that would have been employed in the absence of the SBV project. The X's in the box and whisker plots represent the mean number of people employed, and the dots above the whiskers represent outliers. Just before the SBV Lab contract started, the average non-participant company⁶³ (7.6 employees) was smaller than the average awardee company (13.4 employees). On average, awardee companies increased slightly in size during the SBV Lab contracts, from 13.4 to 14.2. Non-participant companies also increased slightly during the SBV Lab contracts, from 7.6 to 8.9. Awardees estimated that their employment would have been lower had their firm not undertaken the SBV project (12.5 on average, somewhat less than their reported employment either prior to SBV or at time of survey), which compares to non-participant estimates of employment in the absence of SBV equal to employment prior to SBV (7.6). This finding suggests that awardees believed the SBV contracts positively impacted the size of their companies.

⁶² In addition, for firms with follow-on funding and sales, the team investigated their company profile on business research databases, such as www.hoovers.com and www.buzzfile.com, to examine corporate structure, industry, size, and annual revenue. The team found no factors that may explain differences in sales and funding between awardees and non-participants and did not identify any obvious outlier companies.

⁶³ We excluded one very large outlier - a company with over 300 employees - from the mean.

Figure 31: Number Employed at Respondent’s Firm Before and After SBV



*X represents the mean.

5.5 OTHER CONSIDERATIONS

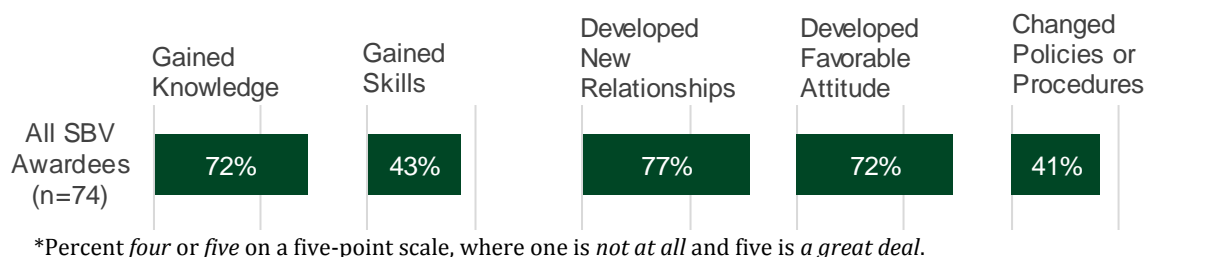
This section discusses additional benefits anticipated by the SBV team.

5.5.1 New Relationships, Knowledge, and Skills

Seventy-seven percent of awardees said they developed new relationships as a result of conducting the SBV project, 72% said they gained knowledge, 72% developed a favorable attitude about working with the Labs, and 43% gained skills. This suggests that the program is having a positive impact both on small business knowledge and skills and on relationships with or perceptions of the Labs (see Figure 32).

The study also asked those non-participants who said their firm had been awarded a CRADA or a different type of cooperative assistance from a Lab in the recent past (2015 or 2016) a follow-up question regarding their experiences working with the lab. Three of the four non-participants who responded to this question said that they gained knowledge and skills and developed new relationships, and two said they changed policies or procedures pertaining to working with the Labs. None of the four non-participants said that they had developed a favorable attitude related to working with the Labs. However, the small sample of non-participants who had a CRADA or other type of cooperative assistance from the Labs makes it hard to draw meaningful conclusions about this group, or this group relative to SBV awardees; therefore, these non-participant data are not included in Figure 32.

Figure 32: Extent to which SBV Firms Experienced the Following Changes through Conducting the SBV Project with the Labs*



After identifying the types of changes respondents’ firms experienced as a result of their experiences with the Labs, respondents described those changes in an open-ended format. Respondents most commonly described an enhanced understanding of technologies, models, and processes. The evaluation team grouped the changes respondents described into the categories presented in Table 18; two non-participants provided responses, and thus the table omits their data. Awardees most often described gaining technical or scientific knowledge (82%) or skills (64%). Changes in attitudes about working with the Labs were based primarily on changed opinions of the Labs’ staff expertise and/or facilities. Respondents who experienced changes in policies and procedures intended to seek additional opportunities to work with the Labs.

Table 18: Description of Changes Experienced through Conducting the SBV Project with the Labs

	All SBV Awardees
Types of Knowledge Gained (n = 49)	
Technical/Scientific Knowledge	82%
Awareness of Lab facilities	14%
Business Knowledge	4%
Types of Skills Gained (n = 33)	
Technical/Scientific Skills	64%
Collaboration Skills	24%
Business Skills	12%
Types of Changes in Attitudes (n = 37)	
Changed Opinion of Lab Staff Expertise/Facilities	92%
Encountered Bureaucratic Challenges	8%
Types of Changes in Policies or Procedures (n = 10)	
Will Seek Additional Opportunities to Work with Labs	100%

5.5.2 Intellectual Property

Development of intellectual property, another anticipated benefit of SBV, is evidenced in patents, copyrights, trademarks, and scientific publications.⁶⁴ As with other metrics we report on, generation of intellectual property may be correlated with project completion, and statistically significantly fewer awardees than non-participants had completed their projects at the time of the survey.

On average, non-participants reported more patents, copyrights, trademarks, and scientific/technical publications applied for/submitted *or received/published* than awardees. Since applying for SBV, non-participants reported *applying for/submitting* an average of 1.7 patents, 0.2 copyrights, 1.1 trademarks, and 1.6 scientific technical publications. In comparison, awardees reported *applying for/submitting* an average of 0.2 patents, zero copyrights and trademarks, and 0.2 scientific technical publications (Table 19).

Table 19: Number of Patents, Copyrights, Trademarks, and/or Scientific Publications Applied for/Submitted

Number Applied for/Submitted	All SBV Awardees (n=52)		Non-participants (n=21)	
	Range	Mean	Range	Mean
Patents	0-3	0.2*	0-6	1.7*
Copyrights	0-0	0.0	0-4	0.2
Trademarks	0-0	0.0	0-10	1.1
Scientific/Technical Publications	0-5	0.2*	0-5	1.6*

* Statistically significantly different at the 90% confidence level.

Non-participants reported *receiving/publishing* an average of 0.8 patents, 0.1 copyrights, 1.4 trademarks, and 1.4 scientific/technical publications. Awardees reported *receiving/publishing* an average of zero patents (one awardee reported receiving one patent), zero copyrights, zero trademarks, and 0.3 scientific/technical publications (5 awardees reported publishing a total of 11 publications, Table 20).

⁶⁴ Unlike laboratories and universities that receive federal funding, and are thus governed by the Bayh-Dole Act, private sector entities are not required to disclose intellectual property.

Table 20: Number of Patents, Copyrights, Trademarks, and/or Scientific Publications Received/Published

Number Received/Published	All SBV Awardees (n=32)		Non-participants (n=13)	
	Range	Mean	Range	Mean
Patents	0-1	0.0*	0-4	0.8*
Copyrights	0-0	0.0	0-1	0.1
Trademarks	0-0	0.0	0-10	1.4
Scientific/Technical Publications	0-5	0.3*	0-4	1.4*

* Statistically significantly different at the 90% confidence level.

5.5.3 Spin-offs, Public Offerings, Acquisitions, and Mergers

Survey respondents were also asked if their company had experienced public offerings, spin-offs, acquisition, or mergers. None of the respondents had made an initial public offering yet. However, 10% of non-participants said they planned to make an initial public offering in the next year, compared to 1% of awardees (Table 21). A larger proportion of non-participants (6%) than awardees (1%) said they had established one or more spin-off companies, while an equal proportion of non-participants and awardees (3%) reported merging with another firm.

Table 21: Initial Public Offerings, Spin-Offs, and Mergers

	All SBV Awardees (n = 75)	Non-participants (n=31)
Planning to make an initial public offering within a year	1%	10%
Established one or more spin-off companies	1%	6%
Been acquired by/merged with another firm	3%	3%
Made an initial public offering	0%	0%

Section 6 Metrics Summary, Conclusions, and Recommendations

Results from the awardee impacts evaluation show positive outcomes for awardees. Their responses also indicate some areas for improvement, particularly related to how the program follows up with unsuccessful applicants.

6.1 METRICS SUMMARY

Table 22 provides a summary of the key outcomes and indicators of the evaluation. Regarding the goal of the engagement of small businesses, SBV awardees report high levels of satisfaction with the application portal and process, contracting, and the quality of work with the labs. We note that shortened contracting was an explicit objective of SBV designers and 91% of awardees rated positively the time it took to contract. Further, nearly all awardees report interest in continuing to work with the labs and intend to recommend that their colleagues work with the labs (both of these metrics are statistically significantly higher for awardees than non-participants).

Regarding lab commercialization assistance, a statistically significantly higher proportion of awardees advanced at least one level on the technology readiness level scale than non-participants (81% and 43%, respectively). In addition, nearly half of awardees (47%) received follow-on funding and nearly one in five (18%) achieved sales of their SBV-related technology. While the average value of follow-on funding and sales are lower for awardees, this may be due to the fact that most awardees are conducting their proposed work with the labs, while most non-participants are running their business as usual, seeking out follow-on funding and of readying their technologies for sale without conducting the proposed research geared toward unique lab services. Given the research in progress, we conclude it is premature to draw conclusions from the comparison of awardees and non-participants with respect to the later outcomes of the SBV pilot.

Given that the SBV research is in progress, we conclude that it is premature to draw conclusions from the comparison of awardees and non-participants with respect to the later outcomes of the SBV pilot, but that the data on early outcomes provides evidence of success in technology advancement. However, we also note that for some impacts, such as development of intellectual property, non-participants appear to have made more progress than awardees

Table 22: Early Outcome Metrics and Data Sources (Surveys)

Metric	Indicator	Awardees	Non-participants
Goal: Engagement of Small Businesses			
Satisfaction with application portal and process ¹	Expectations of the overall funding opportunity notice were met or exceeded	94%	--
	Application process was easier than other federal awards	81%	--
Satisfaction with contracting: expectations were met or exceeded ²	Length of time for contracting	91%	40%
	Expertise of Lab staff involved in contracting	99%	100%
	Treatment of proprietary information	93%	60%
	Contract and Statement of Work process overall	92%	80%
	Understanding of small business needs	88%	80%
Satisfaction with quality of work provided by labs: expectations were met or exceeded ²	Overall voucher project experience	95%	75%
	The expertise of Lab scientists supporting your project	97%	100%
	The quality of the facilities and equipment accessed	96%	100%
	The working relationship with key Lab project personnel	95%	50%
	The fit between your needs (including subjective needs) and Lab services received	90%	50%
Proportion interested in repeated work with lab	Proportion interested in repeated work with lab	89%*	45%*
Proportion recommending to colleagues	Proportion recommending to colleagues	92%*	49%*
Goal: Commercialization Assistance			
Technology readiness (TRL) advancement	Advanced at least one stage of development	81%*	43%*
Follow-on funding obtained	Received follow-on funding	47%	60%
	Average, follow-on funding	\$585,000 – 1,245,000	\$1,338,000 – 2,311,000
Technologies commercially launched	Achieved sales of SBV-related technology	18%	23%
	Average sales	\$26,000 – 150,000	\$61,000 – 214,000
Employment effects from technology	Average number of employees, time of SBV award	13.4	7.6
	Average number of employees, post SBV award	14.2	8.9

¹The study did not seek comparable information from non-participants in the interest of minimizing survey length and burden.

²Non-participant percentages based on the very small subset (n=5) of non-participants that had previously contracted with the labs; thus, we do not assess statistical significance of differences between awardees and non-participants.

*Denotes statistically significant differences between awardees and non-participants.

6.2 RECOMMENDATIONS

Based on results from the impact analysis of SBV awardees, we offer the following recommendations:

1. **Maintain the core elements of the SBV program while seeking to achieve ongoing improvement.** As noted above, the vast majority of awardees (81%) are advancing their technologies and sizeable percentages of awardees are receiving follow-on funding and achieving sales. In addition, SBV awardees report high levels of satisfaction with the application portal and process, contracting, and the quality of work with the labs. They also report interest in continued work with the labs, and have recommended or will recommend that colleagues work with the labs. Areas of improvement identified by SBV awardees centered around six main themes, the most common of which were budget limitations, response time, and process concerns.
2. **Consider improving the quality of feedback to unsuccessful applicants.** Non-participants very consistently reported that the feedback on their application was inadequate. Providing constructive feedback and following up with unsuccessful applicants will likely improve the quality of future submissions while furthering the goal of engaging small businesses. The Labs might also view the work of providing more thorough feedback to unselected applicants as an opportunity to provide more awareness of other Lab programs or information about Lab expertise, as well as an opportunity to provide more general information about technology commercialization.
3. **Considerations for future research.** The evaluation plan includes ongoing research, culminating in a final evaluation report to be completed in 2020. With feedback from the peer review process, the team has identified several areas for further consideration and examination in the ongoing research, including, but not limited to, impacts of factors such as technology type, starting TRL, size of SBV award, and prior commercialization experience on outcomes. In addition, the team will explore methods to improve response rates from non-participants.

Appendix A Technology Readiness Level

Technology Readiness Level, or *TRL*, is a widely-used nine-point scale that indicates the degree of development of a technology toward deployment, with nine being fully deployment ready. At times, EERE has included TRL 10 to indicate commercial production.

- 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 identified.
- 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.
- TRL 10 Production and Sales:** EERE has used this added TRL

Survey respondents assessed the stage of development and commercialization of their technologies. The survey used a scale that paraphrased DOE's TRL descriptions for brevity and simplicity.⁶⁵ The table below compares the commercialization stages used in the SBV survey to TRLs.

⁶⁵ The team used a Minnesota Department of Commerce memo on commercialization milestones to develop the seven-point scale used in the survey; the memo was based on US DOE and DOD commercialization metrics. <http://mn.gov/commerce-stat/pdfs/commercialization-milest-success.pdf>

Table 23: Comparing SBV Survey Commercialization Stage to TRLs

SBV Survey Commercialization Stage	TRL
1. Concept exploration/preliminary investigation	TRL 1 Basic Research: Initial scientific research has been conducted. Principles are qualitatively postulated and observed. Focus is on new discovery rather than applications.
2. Concept definition/initial investigation	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 identified.
3. Proof of concept/detailed investigation	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.
4. Proof of application/initial development and verification	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.
5. Validation in simulated operation environment/prototype project	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).
6. Validation in commercial operational environment/commercial scale	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. TRL 9 can be as few as one unit produced.
7. Final design/commercial production	TRL 10 production and sales: EERE has used this added TRL
8. Initial sales (sales to early adopters)	
9. Diversification/market success	

Appendix B Awardee and Non-participant Surveys

B.1 AWARDEE/PARTICIPANTS

Small Business Voucher Pilot Annual Participant Survey

OMB Control #: 1910-5180

Exp. Date: 10/31/19

Burden Disclosure Statement:

Public reporting burden for this collection of information is estimated to average (30 minutes) per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Office of the Chief Information Officer, Enterprise Policy Development & Implementation Office, IM-22, Paperwork Reduction Project (1910 5180), U.S. Department of Energy, 1000 Independence Ave SW, Washington, DC, 20585-1290; and to the Office of Management and Budget (OMB), OIRA, Paperwork Reduction Project (1910 5180), Washington, DC 20503.

Submission of this data is (voluntary).

B.1.1 Introduction

Thank you for taking the time to provide feedback on the U.S. Department of Energy's (DOE) Small Business Voucher Pilot, or SBV.

We appreciate your willingness to complete this survey. You can stop at any time. The survey should take about 30 minutes to complete. If you need to take a break before you are finished, you can exit and later click the same link again to resume where you left off.

Your input is extremely valuable and will help to improve Laboratory assistance to small businesses.

The U.S. DOE has contracted with an independent research team led by NMR Group. All reporting to the U.S. DOE will use only summary-level data and will not identify individual respondents or organizations.

B.1.2 Screening

[SURVEY PROGRAMMING NOTES: Programming instructions are in bracketed CAPS]

[ENSURE THERE IS A COMPANY ID FOR EACH RESPONDENT].

SC1. Please confirm whether your firm was awarded a Small Business Voucher (SBV) in 2015/2016.

- 1 Yes, awarded SBV voucher
- 2 No, not awarded SBV voucher (exit questionnaire)
- 97 Don't Know (exit questionnaire)
- 98 Refused (exit questionnaire)

SC2. What was your role with the firm at the time it received the SBV award? Please select all that apply [SBIR1].

- 1. Project lead (Principal Investigator (PI), project manager, etc.)
- 2. Project team member (other than lead)
- 3. Senior executive with the firm awarded the SBV voucher
- 4. None of the above, but very familiar with the project
- 5. None of the above (exit questionnaire)

B.1.3 Previous Experience with the National Laboratories and Commercialization

Q1 Before the SBV pilot, had you or your firm ever sought information about the energy-related technologies, facilities or staff expertise at any of the U.S. Department of Energy National Laboratories?

- 1 Yes
- 2 No
- 97 Don't Know
- 98 Refused

Q2 Before the SBV pilot, had you or your firm ever partnered or worked with the Labs in any of the following ways?

Item	1.YES	2.NO	97 DK	98 RF
a. Cooperative Research and Development Agreements (CRADA)				
b. Small Business Innovation Research (SBIR) awards				
c. Work for Others (WFO) Agreement				
d. Technical Assistance Program				
e. Agreements for Commercializing Technology (ACT)				
f. Technology Licensing Agreement				
g. User Agreements				
h. Other [SPECIFY: _____]				
i. No prior partnerships				

Q3 [IF ANY Q#2=YES (PRIOR PARTNERSHIPS)]

How did you or your firm learn about the opportunity to partner or work with the Labs?

Item	1.YES	2.NO	97 DK	98 RF
a. Press releases from U.S. Department of Energy				
b. Press releases from an individual National Lab				

c. Outreach from Lab staff (personal or an event)				
d. Outreach from another small business support program or effort				
e. Outreach from an energy-efficiency or renewable energy program				
f. From a friend or another small business				
g. Media (newspaper stories, radio, television, internet)				
h. Other [SPECIFY]				

Q4 [IF ALL Q#2=No prior partnerships] Why had you or your firm not partnered or worked with the Labs?

Item	1.YES	2.NO	97 DK	98 RF
a. Not aware of the National Labs				
b. Not aware of the relevant technical capabilities of the National Labs				
c. Not aware of the opportunities to partner with the National Labs				
d. Not aware of how to partner with the National Labs				
e. Too difficult or complicated to partner with the National Labs				
f. Too expensive to partner with the National Labs				
g. Did not have time or staff resources to seek out opportunities				
h. Other [SPECIFY:_____]				

Q5. What has been your firm’s experience with commercialization? [~SBIR Q17]

Item	1.YES	2.NO	97 DK	98 RF
a. One or more company staff have taken a course on the commercialization process				
b. One or more company staff have taken a single technology to commercialization in the past				
c. One or more company staff have taken multiple technologies to commercialization				
d. No experience				
e. Other [SPECIFY]				

B.1.4 Your SBV Pilot Experiences

[PROCESS QUESTIONS, FIRST YEAR ONLY]

[OUTREACH]

Q6. How did you or your firm learn about the Small Business Voucher opportunity?

Item	1.YES	2.NO	97 DK	98 RF
a. Press releases from U.S. Department of Energy				
b. Press releases from an individual National Lab				
c. Outreach from Lab staff (personal or an event)				
d. Outreach from another small business support program or effort				
e. Outreach from an energy-efficiency or renewable energy program or effort				
f. From a friend or another small business				
g. Media (newspaper stories, radio, television, internet)				
h. Other [SPECIFY]				

Q7 Please rate the comprehensiveness of the topics addressed on the SBV “Central Assistance Portal” (CAP, the web portal). [PROGRAMMER: RANDOMIZE ITEMS]

Topic	Comprehensiveness [1 = not at all comprehensive, 5 = very comprehensive]
a. SBV program	
b. Lab capabilities	
c. Application process	
d. Application selection criteria	
e. Contracting process	

Q8 Please rate the usefulness of the topics addressed on the SBV CAP (web portal). [PROGRAMMER: RANDOMIZE ITEMS]

Topic	Usefulness [1 = not at all useful, 5 = very useful]
a. SBV program	
b. Lab capabilities	
c. Application process	
d. Application selection criteria	
e. Contracting process	

Q9 Please rate how easy it was for you to navigate SBV CAP (web portal).

[1=NOT AT ALL EASY TO NAVIGATE, 5=VERY EASY TO NAVIGATE]

[APPLICATION AND SELECTION PROCESS]

Q10. Please rate the extent to which your expectations were met by the following aspects of the voucher application process and the funding opportunity notice.

Item	1=fell short of my expectations	2=met my expectations	3=exceeded my expectations	96. NA	97 DK	98 RF
a. Multiple calls for applications						
b. Fairness of the selection process as described on the SBV CAP (web portal)						
c. Fairness of the selection criteria as described on the SBV CAP (web portal)						
d. Level of effort and/or length of time needed to complete and submit an application						
e. Time between application and notification of selection						
f. Funding opportunity notice overall						

Q11. In comparison to other Federal awards or Federal funding, how would you rate the process of applying for SBV funding? Applying for SBV funding was..." [SBIR41]

1. Much easier than applying for other Federal awards
2. Easier
3. About the same
4. More difficult
5. Much more difficult
6. Not sure, not applicable, or not familiar with other Federal awards or funding

[SOW PROCESS]

Next, we have some questions about your agreements with the Lab and your Statement of Work (SOW)

Q12. What type of contract or agreement did your firm have with the Lab? [MATRIX QUESTION]

ITEM	1.YES	2.NO	97 DK	98 RF
a. TAPA – DOE-Funded Technical Assistance Pilot Agreement				
b. Short CRADA – SBV Program Cooperative Research and Development Agreement				

Q13. Please rate the extent to which your expectations were met by the following aspects of your firms' SBV contract and the associated Statement of Work.

[MATRIX QUESTION: SCALE]

Item	1=fell short of my expectations	2=met my expectations	3=exceeded my expectations	96. NA	97 DK	98 RF
a. Expertise of Lab staff involved in contracting						
b. Courteousness of Lab staff involved in contracting						

c. Understanding of small business needs by Lab staff involved in contracting						
d. Definition of tasks						
e. Definition of task outcomes or milestones						
f. Setting of deadlines						
g. Assignment of intellectual property						
h. Treatment of proprietary information, confidentiality						
i. Length of time it took to develop the SOW						
j. The Standard contract form and its contents overall [PROVIDE POP-UP INFORMATION TO RESPONDENT: <i>The standard contract for was either a TAPA – DOE-Funded Technical Assistance Pilot Agreement, or a Short CRADA – SBV Program Cooperative Research and Development Agreement]</i>						
k. Contract and Statement of Work process overall						

[WORK DURING THE PROJECT]

Q14. Please rate the extent to which your expectations were met by the following aspects of your firms' SBV project.

[MATRIX QUESTION: SCALE]

Item	1=fell short of my expectations	2=met my expectations	3=exceeded my expectations	96. NA	97 DK	98 RF
a. The quality of the facilities and equipment accessed						
c. The expertise of Lab scientists supporting your project						
d. The working relationship with key Lab project personnel						
e. The courteousness of Lab staff supporting your project						
f. The amount of Lab assistance you received						
g. The fit between your needs (including subjective needs) and Lab services received						
h. Overall voucher project experience						

Q15. How adequate was the amount of money you received through SBV funding for the purposes you applied for? Was it. [SBIR42]

1. More than enough
2. About the right amount
3. Not enough

B.1.5 Outcomes from the SBV Pilot

Q16 Please rate the extent to which you or staff in your firm experienced the following through conducting the SBV project.

[MATRIX QUESTION: SCALE]

Item	1=not at all	2	3	4	5=a great deal	96. NA	97 DK	98 RF
a. Gained knowledge								
b. Gained skills								
c. Developed new relationships								
d. Developed a favorable attitude about working with the Labs?								
e. Changed policies or procedures pertaining to working with the Labs?								

Q17. [FOR RESPONSE >2 TO Q#16ABOVE, ASK APPROPRIATE OPEN-ENDED FOLLOW UP:]

- a. Please describe the knowledge gained
- b. Please describe the skills gained
- c. Please describe the change in attitudes about with the Labs
- d. Please describe the change in policies or procedures pertaining to working with the Labs

Q18. Please indicate the stage of development/commercialization that best described your innovation at the time of SBV award, and the stage that best describes your innovation today. [CONSTRAIN TO A SINGLE RESPONSE IN COLUMN A AND A SINGLE RESPONSE IN COLUMN B]

Stage of development/commercialization	(A) Time of SBV Award	(B) Today
1. Concept exploration/preliminary investigation		
2. Concept definition/initial investigation		
3. Proof of concept/detailed investigation		
4. Proof of application/initial development and verification		
5. Validation in simulated operation environment/prototype project		
6. Validation in commercial operational environment/commercial scale		
7. Final design/commercial production		
8. Initial sales (sales to early adopters)		
9. Diversification/market success		

Q19. What is the current status of your firm’s SBV project? Select the one best answer [SBIR30]

- 1. Firm has not yet completed SBV funded research.
- 2. Firm’s efforts related to this project have been discontinued AND no sales or additional funding resulted from this project.
- 3. Firm’s efforts related to this project have been discontinued AND the project did result in sales, licensing of technology, or additional funding.
- 4. Firm is continuing post-award technology development related to this project.
- 5. Commercialization is underway.
- 6. Products/Processes/Services are in use by target population/customer/consumers.
- 7. Products/Processes/Services are in use by population/customer/consumers not anticipated at the time of the award (for example, in a different industry).

Q20. Which if any of the following has the firm experienced as a result of the SBV program? [SBIR10]

[MATRIX QUESTION]

Item	1. YES	2. NO	97 DK	98 RF
a. Made an initial public offering				
b. Planning to make an initial public offering in the next year				
c. Established one or more spin off companies				
d. Been acquired by/merged with another firm				

Q21. Have you received or invested any additional developmental funding in this project subsequent to the SBV award? [SBIR33]

1. Yes
2. No [IF NO, SKIP TO Q24]

Q22. Please indicate the total additional developmental funding and sources of funding that your firm has received to date for the technology developed during this project, subsequent to the SBV award. [SBIR34]

[MATRIX QUESTION]

Funding Source	\$0	\$1 to \$99,999	\$100,000 to \$499,999	\$500,000 to \$999,999	\$1,000,000 to \$4,999,999	\$5,000,000 to \$9,999,999	\$10,000,000 and up	97 DK	98 RF
a. Federal Funds - non-SBV funds									
b. Private Investment - U.S. venture capital									
c. Private Investment - Foreign investment									
d. Private Investment - Other Private equity (including angel funding)									
e. Private Investment - Other domestic private company									
f. Other sources - State or local governments									
g. Other sources - College or Universities									
h. Not previously reported - Your firm's funds (including money your firm has borrowed)									
i Not previously reported - Personal funds									

Q23. [IF FEDERAL FUNDS > \$0, IN Q#22 ASK:] Please specify the non-SBV Federal funds. [RECORD OPEN-ENDED RESPONSE]

Q24. Has the company and/or licensee had any actual sales of products, processes, services or other sales incorporating the technology developed during this project? [SBIR35]

Item	1.YES	2.NO	97 DK	98 RF
a. No sales to date nor are sales expected				
b. No sales to date, but sales are expected				
c. Sales of product(s)				
d. Sales of process(es)				
e. Sales of services(s)				
f. Other sales (e.g., rights to technology, licensing, etc.)				

[IF a=Y AND b=Y, SKIP TO Q#28]

Q25. For the company and/or the licensee(s), when did the first sale occur resulting from the technology developed during the SBV pilot? [RESPONSE INCLUDES MONTH AND YEAR FIELDS] [SBIR36a]

Q26. For the company and/or the licensee(s), what is the approximate amount of total sales dollars of product(s), process(es) or services to date resulting from the technology developed during the SBV pilot? [SBIR36b]

For the company [PULLDOWN WITH CHOICES: 0, <\$100,000, \$100,000-\$499,999, \$500,000-\$999,999, \$1,000,000-\$4,999,999, \$5,000,000-\$9,999,999, \$10,000,000-\$19,999,999, \$20,000,000-\$49,999,999, \$50,000,000+]

For any licensees [PULLDOWN WITH SAME CHOICES]

Q27. For the company and/or the licensee(s), what is the approximate amount of other total sales dollars (e.g., rights to technology, sale of spin-off company, etc.) to date resulting from the technology developed during the SBV pilot? [SBIR36c]

For the company [PULLDOWN WITH CHOICES: 0, <\$100,000, \$100,000-\$499,999, \$500,000-\$999,999, \$1,000,000-\$4,999,999, \$5,000,000-\$9,999,999, \$10,000,000-\$19,999,999, \$20,000,000-\$49,999,999, \$50,000,000+]

For any licensees [PULLDOWN WITH SAME CHOICES]

Q28. Please give the number of patents, copyrights, trademarks and/or scientific publications for the technology developed as a result of the SBV project. Enter numbers. If none, enter 0 (zero). [SBIR39]

	Number Applied For/Submitted	Number Received/Published
Patents		
Copyrights		
Trademarks		
Scientific		

Q29. Thinking back to just before your Lab contract for SBV started, please estimate the number of people employed at your firm. [CONSTRAIN RESPONSES TO NUMERIC]

Q30. About how many people does the firm employ now? [CONSTRAIN RESPONSES TO NUMERIC]

Q31. Had your firm *not* undertaken the SBV project, about how many people do you estimate would be employed at your firm now? [CONSTRAIN RESPONSES TO NUMERIC]

Q32. In your opinion, in the absence of this SBV award, would the company have undertaken this project? [SELECT ONE] [SBIR24]

1. Definitely yes
2. Probably yes
3. Uncertain
4. Probably not
5. Definitely not

[PROGRAMMER: IF Q#32 = a or b, GO TO Q#33. IF Q#32 =c, d, or e, GO TO Q#35 (FIRST QUESTION IN NEXT SECTION, "FUTURE ENGAGEMENT")]

Q33. If you had undertaken this project in the absence of SBV, this project would have been [SELECT ONE] [SBIR25]

1. Broader in scope
2. Similar in scope
3. Narrower in scope

Q34. Please provide your best estimates of what would have occurred in the absence of SBV funding. [SBIR26]

- a. how long would the start of this project have been delayed? [TEXT BOX – MONTHS; ENTER 0 IF NO DELAY]
- b. the expected duration/time to completion would have been... [SELECT ONE]
 - 1) longer
 - 2) the same
 - 3) shorter
- c. in achieving similar goals and milestones, the project would be... [SELECT ONE]
 - 1) ahead
 - 2) the same place
 - 3) behind

B.1.6 Future Engagement

Q35. Please rate the likelihood that you will work with the Labs again. [1= NOT AT ALL LIKELY, 5= VERY LIKELY; 97 = DON'T KNOW]

Q36. Have you, or will you, recommend to your colleagues in other small businesses that they work with the Labs?

- 1 Yes, I have recommended my colleagues that they work with the Labs
- 2 Yes, I likely will recommend my colleagues that they work with the Labs
- 3 No
- 97 Don't Know

Q37. (If Q#36 = 1 (have recommended). To about how many colleagues have you made this recommendation? [CONSTRAIN TO NUMERIC RESPONSE]

Q38. (If Q#36 = 2 (will recommend). To about how many colleagues do you anticipate making this recommendation? [CONSTRAIN TO NUMERIC RESPONSE]

Q39. (If Q#36 = 3 (no). Why do you think you will not or might not recommend SBV to your colleagues? [PROGRAMMER: OPEN ENDED]

B.1.7 Recommendations for the SBV Pilot

Q40. [YEAR ONE SURVEY ONLY] Do you have any suggestions for improving the SBV program?

B.2 NON-PARTICIPANTS

Small Business Voucher Pilot Annual Comparison Group Survey

OMB Control #: 1910-5180

Exp. Date: 10/31/19

Burden Disclosure Statement:

Public reporting burden for this collection of information is estimated to average (30 minutes) per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Office of the Chief Information Officer, Enterprise Policy Development & Implementation Office, IM-22, Paperwork Reduction Project (1910 5180), U.S. Department of Energy, 1000 Independence Ave SW, Washington, DC, 20585-1290; and to the Office of Management and Budget (OMB), OIRA, Paperwork Reduction Project (1910 5180), Washington, DC 20503.

Submission of this data is (voluntary).

B.2.1 Introduction

[COMPARISON = 1 IF MATCHED FROM LIST OF UNSELECTED SBV APPLICANTS;

COMPARISON = 2 IF MATCHED FROM NATIONAL LAB CRADAS]

[INTRO IF COMPARISON = 1] Thank you for taking the time to provide feedback on your experience with applying to the Small Business Voucher, or SBV, pilot program and your experience with the National Laboratories. Your feedback will help with the evaluation of the U.S. Department of Energy's (DOE) SBV Pilot.

We appreciate your willingness to complete this survey. Participating in this study is voluntary. You can stop at any time. The survey should take about 30 minutes to complete. If you need to take a break before you are finished, you can exit and later click the same link again to resume where you left off.

Your input is extremely valuable and will help to improve Laboratory assistance to small businesses.

The U.S. DOE has contracted with an independent research team led by NMR Group. All reporting to the U.S. DOE will use only summary-level data and will not identify individual respondents or organizations.

[INTRO IF COMPARISON = 2] Thank you for taking the time to provide feedback on your Cooperative Research and Development Agreements (CRADA) with the National Labs. Your feedback will help with the evaluation of the U.S. Department of Energy's (DOE) Small Business Voucher Pilot, or SBV, which takes a slightly different approach to engaging small businesses with the National Laboratories.

We appreciate your willingness to complete this survey. Participating in this study is voluntary. You can stop at any time. The survey should take about 30 minutes to complete. If you need to take a break before you are finished, you can exit and later click the same link again to resume where you left off.

Your input is extremely valuable and will help to improve Laboratory assistance to small businesses.

The U.S. DOE has contracted with an independent research team led by NMR Group. All reporting to the U.S. DOE will use only summary-level data and will not identify individual respondents or organizations.

B.2.2 Screening

[SURVEY PROGRAMMING NOTES: Programming instructions are in bracketed CAPS]

[ENSURE THERE IS A COMPANY ID FOR EACH RESPONDENT].

SC1. Please confirm whether your firm was awarded a Cooperative Research and Development Agreements (CRADA) or some other type of cooperative assistance from a Lab in 2015/2016.

1 Yes, awarded a CRADA

2 Yes, awarded a different type of cooperative assistance from a Lab [SPECIFY: ____]

2 No, not awarded a CRADA voucher or any other type of cooperative assistance

- 97 Don't Know (exit questionnaire)
- 98 Refused (exit questionnaire)

SC2. What was your role with the firm at the time it [IF COMPARISON = 1 “applied for an SBV”; IF COMPARISON = 2 “received the CRADA”]? Please select all that apply [SBIR1].

1. Project lead (Principal Investigator (PI), project manager, etc.)
2. Project team member (other than lead)
3. Senior executive with the firm
4. None of the above, but very familiar with the project
5. None of the above (exit questionnaire)

B.2.3 Previous Experience with the National Laboratories and Commercialization

Q1 Before [IF COMPARISON = 1 “you applied for an SBV;” IF COMPARISON = 2 “your current CRADA”], had you or your firm ever sought information about the energy-related technologies, facilities or staff expertise at any of the U.S. Department of Energy National Laboratories?

- 1 Yes
- 2 No
- 97 Don't Know
- 98 Refused

Q2 Before [IF COMPARISON = 1 “you applied for an SBV”; IF COMPARISON = 2 “your current CRADA”], had you or your firm ever partnered or worked with the Labs in any of the following ways?

Item	1.YES	2.NO	97 DK	98 RF
a. Cooperative Research and Development Agreements (CRADA)				
b. Small Business Innovation Research (SBIR) awards				
c. Work for Others (WFO) Agreement				
d. Technical Assistance Program				
e. Agreements for Commercializing Technology (ACT)				
f. Technology Licensing Agreement				
g. User Agreements				
h. Other [SPECIFY: _____]				
i. No prior partnerships				

Q3 [IF ANY Q#2=YES (PRIOR PARTNERSHIPS)]

How did you or your firm learn about that earlier opportunity to partner or work with the Labs?

Item	1.YES	2.NO	97 DK	98 RF
a. Press releases from U.S. Department of Energy				
b. Press releases from an individual National Lab				
c. Outreach from Lab staff (personal or an event)				
d. Outreach from another small business support program or effort				
e. Outreach from an energy-efficiency or renewable energy program				
f. From a friend or another small business				
g. Media (newspaper stories, radio, television, internet)				
h. Other [SPECIFY]				

Q4 [IF ALL Q#2=No prior partnerships] Why had you or your firm not partnered or worked with the Labs?

Item	1.YES	2.NO	97 DK	98 RF
a. Not aware of the National Labs				
b. Not aware of the relevant technical capabilities of the National Labs				
c. Not aware of the opportunities to partner with the National Labs				
d. Not aware of how to partner with the National Labs				
e. Too difficult or complicated to partner with the National Labs				
f. Too expensive to partner with the National Labs				
g. Did not have time or staff resources to seek out opportunities				
h. Other [SPECIFY: _____]				

Q5. What has been your firm’s experience with commercialization? [~SBIR Q17]

Item	1.YES	2.NO	97 DK	98 RF
a. One or more company staff have taken a course on the commercialization process				
b. One or more company staff have taken a single technology to commercialization in the past				
c. One or more company staff have taken multiple technologies to commercialization				
This project is our first experience.				
d. No experience				
e. Other [SPECIFY]				
Don’t know				

B.2.4 Your Experiences with the National Labs

[PROCESS QUESTIONS, FIRST YEAR ONLY] [IF SC1. = 3 (NO CRADA OR OTHER COOPERATIVE ASSISTANCE), SKIP TO Q18]

[OUTREACH]

Q6. How did you or your firm learn about the [IF COMPARISON = 1 “the SBV pilot;” IF COMPARISON = 2 “2015-2016 CRADA”] opportunity?

Item	1.YES	2.NO	97 DK	98 RF
a. Press releases from U.S. Department of Energy				
b. Press releases from an individual National Lab				
c. Outreach from Lab staff (personal or an event)				
d. Outreach from another small business support program or effort				
e. Outreach from an energy-efficiency or renewable energy program or effort				
f. From a friend or another small business				
g. Media (newspaper stories, radio, television, internet)				
h. Other [SPECIFY]				

[SOW PROCESS]

Next, we have some questions about your agreement with the Lab and your Statement of Work (SOW)

Q12. What type of contract or agreement did your firm have with the Lab? [MATRIX QUESTION]

ITEM	1.YES	2.NO	97 DK	98 RF
a. TAPA – DOE-Funded Technical Assistance Pilot Agreement				
b. Short CRADA –Cooperative Research and Development Agreement				
c. Other [specify]				

Q13. Please rate the extent to which your expectations were met by the following aspects of your firms' [IF COMPARISON = 1 “cooperative assistance from the Lab”; IF COMPARISON = 2 “CRADA”] and the associated Statement of Work.

[MATRIX QUESTION: SCALE]

Item	1=fell short of my expectations	2=met my expectations	3=exceeded my expectations	96. NA	97 DK	98 RF
a. Expertise of Lab staff involved in contracting						
b. Courteousness of Lab staff involved in contracting						
c. Understanding of small business needs by Lab staff involved in contracting						
d. Definition of tasks						
e. Definition of task outcomes or milestones						
f. Setting of deadlines						
g. Assignment of intellectual property						
h. Treatment of proprietary information, confidentiality						
i. Length of time it took to develop the SOW						
j. The Standard contract form and its contents overall [PROVIDE POP-UP INFORMATION TO RESPONDENT: <i>The standard contract for was either a TAPA – DOE-Funded Technical Assistance Pilot Agreement, or a Short CRADA – SBV Program Cooperative Research and Development Agreement</i>]						
k. Contract and Statement of Work process overall						

[WORK DURING THE PROJECT]

Q14. Please rate the extent to which your expectations were met by the following aspects of your firms' [IF COMPARISON = 1 “cooperative assistance from the Lab”; IF COMPARISON = 2 “CRADA”].

[MATRIX QUESTION: SCALE]

Item	1=fell short of my expectations	2=met my expectations	3=exceeded my expectations	96. NA	97 DK	98 RF
a. The quality of the facilities and equipment accessed						
c. The expertise of Lab scientists supporting your project						
d. The working relationship with key Lab project personnel						
e. The courteousness of Lab staff supporting your project						
f. The amount of Lab assistance you received						
g. The fit between your needs (including subjective needs) and Lab services received						
h. Overall project experience						

Q15. How adequate was the Laboratory support you received through the [IF COMPARISON = 1 “cooperative assistance from the Lab”; IF COMPARISON = 2 “CRADA experience”]? Was it. [SBIR42]

1. More than enough
2. About the right amount
3. Not enough

B.2.5 Outcomes from the Experiences with the National Labs

Q16 Please rate the extent to which you or staff in your firm experienced the following through completing the [IF COMPARISON = 1 “cooperative assistance from the Lab”; IF COMPARISON = 2 “CRADA project”].

[MATRIX QUESTION: SCALE]

Item	1=not at all	2	3	4	5=a great deal	96. NA	97 DK	98 RF
a. Gained knowledge								
b. Gained skills								
c. Developed new relationships								
d. Developed a favorable attitude about working with the Labs								
e. Changed policies or procedures pertaining to working with the Labs								

Q17. [FOR RESPONSE >2 TO Q#16ABOVE, ASK APPROPRIATE OPEN-ENDED FOLLOW UP:]

- e. Please describe the knowledge gained
- f. Please describe the skills gained
- g. Please describe the change in attitudes about with the Labs
- h. Please describe the change in policies or procedures pertaining to working with the Labs

Q18. Please indicate the stage of research/development/commercialization that best described your project/technology at the time [IF COMPARISON = 1 “you applied for an SBV”; IF COMPARISON = 2 “your current CRADA began”], and the stage that best describes your project/technology today. [CONSTRAIN TO A SINGLE RESPONSE IN COLUMN A AND A SINGLE RESPONSE IN COLUMN B]

Stage of development/commercialization	(A) [IF COMPARISON = 1 “Applied for an SBV”; IF COMPARISON = 2 “Beginning of CRADA “]	(B) Today
10. Concept exploration/preliminary investigation		
11. Concept definition/initial investigation		
12. Proof of concept/detailed investigation		
13. Proof of application/initial development and verification		
14. Validation in simulated operation environment/prototype project		
15. Validation in commercial operational environment/commercial scale		
16. Final design/commercial production		
17. Initial sales (sales to early adopters)		
18. Diversification/market success		

Q19. What is the current status of your firm’s [IF COMPARISON = 1 “SBV-related project”; IF COMPARISON = 2 “CRADA-related project? Select the one best answer [SBIR30]

- 1. Firm has not yet completed research.
- 2. Firm’s efforts related to this project have been discontinued AND no sales or additional funding resulted from this project.
- 3. Firm’s efforts related to this project have been discontinued AND the project did result in sales, licensing of technology, or additional funding.
- 4. Firm is continuing post-award technology development related to this project.
- 5. Commercialization is underway.
- 6. Products/Processes/Services are in use by target population/customer/consumers.
- 7. Products/Processes/Services are in use by population/customer/consumers not anticipated at the time of the award (for example, in a different industry).

Q20. Which if any of the following has the firm experienced since [IF COMPARISON = 1 “you applied for an SBV”; IF COMPARISON = 2 “your current CRADA began”]? [SBIR10]

[MATRIX QUESTION]

Item	1.YES	2.NO	97 DK	98 RF
a. Made an initial public offering				
b. Planning to make an initial public offering in the next year				
c. Established one or more spin off companies				
d. Been acquired by/merged with another firm				

Q21. Have you received or invested any additional developmental funding in this project since March 2016? [SBIR33]

1. Yes
2. No [IF NO, SKIP TO Q24]

Q22. Please indicate the total additional developmental funding and sources of funding that your firm has received to date for the technology developed during this project, [IF COMPARISON = 1 “subsequent to applying for an SBV”; IF COMPARISON = 2 “subsequent to the CRADA”] [SBIR34]

[MATRIX QUESTION]

Funding Source	\$0	\$1 to \$99,999	\$100,000 to \$499,999	\$500,000 to \$999,999	\$1,000,000 to \$4,999,999	\$5,000,000 to \$9,999,999	\$10,000,000 and up	97 DK	98 RF
a. Federal Funds - non-CRADA / current cooperative assistance									
b. Private Investment - U.S. venture capital									
c. Private Investment - Foreign investment									
d. Private Investment - Other Private equity (including angel funding)									
e. Private Investment - Other domestic private company									
f. Other sources - State or local governments									
g. Other sources - College or Universities									

h. Not previously reported - Your firm's funds (including money your firm has borrowed)									
i Not previously reported - Personal funds									

Q23. [IF FEDERAL FUNDS > \$0, IN Q#22 ASK:] Please specify the non-CRADA /cooperative assistance Federal funds. [RECORD OPEN-ENDED RESPONSE]

Q24. Has the company and/or licensee had any actual sales of products, processes, services or other sales incorporating the technology developed during this project? [SBIR35]

Item	1.YES	2.NO	97 DK	98 RF
a. No sales to date nor are sales expected				
b. No sales to date, but sales are expected				
c. Sales of product(s)				
d. Sales of process(es)				
e. Sales of services(s)				
f. Other sales (e.g., rights to technology, licensing, etc.)				

[IF a=Y AND b=Y, SKIP TO Q#28]

Q25. For the company and/or the licensee(s), when did the first sale occur resulting from the technology developed [IF COMPARISON = 1 "since you applied for an SBV"; IF COMPARISON = 2 "during your current CRADA]? [RESPONSE INCLUDES MONTH AND YEAR FIELDS] [SBIR36a]

Q26. For the company and/or the licensee(s), what is the approximate amount of total sales dollars of product(s), process(es) or services to date resulting from the technology developed [IF COMPARISON = 1 "since you applied for an SBV"; IF COMPARISON = 2 "during your current CRADA]? [SBIR36b]

For the company [PULLDOWN WITH CHOICES: 0, <\$100,000, \$100,000-\$499,999, \$500,000-\$999,999, \$1,000,000-\$4,999,999, \$5,000,000-\$9,999,999, \$10,000,000-\$19,999,999, \$20,000,000-\$49,999,999, \$50,000,000+]

For any licensees [PULLDOWN WITH SAME CHOICES]

Q27. For the company and/or the licensee(s), what is the approximate amount of other total sales dollars (e.g., rights to technology, sale of spin-off company, etc.) to date resulting from the technology developed [IF COMPARISON = 1 "since you applied for an SBV"; IF COMPARISON = 2 "during your current CRADA]? [SBIR36c]

For the company [PULLDOWN WITH CHOICES: 0, <\$100,000, \$100,000-\$499,999, \$500,000-\$999,999, \$1,000,000-\$4,999,999, \$5,000,000-\$9,999,999, \$10,000,000-\$19,999,999, \$20,000,000-\$49,999,999, \$50,000,000+]

For any licensees [PULLDOWN WITH SAME CHOICES]

Q28. Please give the number of patents, copyrights, trademarks and/or scientific publications for the technology developed [IF COMPARISON = 1 “since you applied for an SBV”; IF COMPARISON = 2 “as a result of your current CRADA]. Enter numbers. If none, enter 0 (zero). [SBIR39]

	Number Applied For/Submitted	Number Received/Published
Patents		
Copyrights		
Trademarks		
Scientific/Technical Publications		

Q29. Thinking back to just before [IF COMPARISON = 1 “you applied for an SBV”; IF COMPARISON = 2 “your Lab contract for your current CRADA started], please estimate the number of people employed at your firm. [CONSTRAIN RESPONSES TO NUMERIC]

Q30. About how many people does the firm employ now?

Q31. Had your firm *not* [IF COMPARISON = 1 “applied for an SBV”; IF COMPARISON = 2 “undertaken the CRADA started], about how many people do you estimate would be employed at your firm now? [CONSTRAIN RESPONSES TO NUMERIC]

Q32. In your opinion, in the absence of [IF COMPARISON = 1 “applying for an SBV”; IF COMPARISON = 2 “this CRADA], would the company have undertaken this project? [SELECT ONE] [SBIR24]

1. Definitely yes
2. Probably yes
3. Uncertain
4. Probably not
5. Definitely not

[PROGRAMMER: IF Q#32 = a or b, GO TO Q#33. IF Q#32 =c, d, or e, GO TO Q#35 (FIRST QUESTION IN NEXT SECTION, “FUTURE ENGAGEMENT”)]

Q33. If you had undertaken this project in the absence of [IF COMPARISON = 1 “applying for an SBV”; IF COMPARISON = 2 “the CRADA], this project would have been [SELECT ONE] [SBIR25]

1. Broader in scope
2. Similar in scope
3. Narrower in scope

Q34. Please provide your best estimates of what would have occurred in the absence of IF COMPARISON = 1 “applying for an SBV”; IF COMPARISON = 2 “the CRADA]. [SBIR26]

- a. how long would the start of this project have been delayed? [TEXT BOX – MONTHS; ENTER 0 IF NO DELAY]
- b. the expected duration/time to completion would have been... [SELECT ONE]

- 1) longer
 - 2) the same
 - 3) shorter
- c. in achieving similar goals and milestones, the project would be... [SELECT ONE]
- 1) ahead
 - 2) the same place
 - 3) behind

B.2.6 Future Engagement

Q35. Please rate the likelihood that you will work with the Labs again. [1= NOT AT ALL LIKELY, 5= VERY LIKELY; 97 = DON'T KNOW]

Q36. Have you, or will you, recommend to your colleagues in other small businesses that they work with the Labs?

- 1 Yes, I have recommended my colleagues that they work with the Labs
- 2 Yes, I likely will recommend my colleagues that they work with the Labs
- 3 No
- 97 Don't Know

Q37. (If Q#36 = 1 (have recommended). To about how many colleagues have you made this recommendation? [CONSTRAIN TO NUMERIC RESPONSE]

Q38. (If Q#36 = 2 (will recommend). To about how many colleagues do you anticipate making this recommendation? [CONSTRAIN TO NUMERIC RESPONSE]

Q39. (If Q#36 = 3 (no). Why do you think you will not or might not recommend IF COMPARISON = 1 "working with the Labs"; IF COMPARISON = 2 "CRADAs" to your colleagues? [PROGRAMMER: OPEN ENDED]

B.2.7 Recommendations for CRADAs

Q40. [YEAR ONE SURVEY ONLY] Do you have any suggestions for improving the IF SC1= 2 "Lab's cooperative assistance experience for small businesses;" IF COMPARISON = 2 "the CRADA experience for small businesses]?

Appendix C Detailed Survey Results

This appendix contains additional details from the surveys, including results broken out by awardee round.

C.1 BASELINE CHARACTERISTICS AND PRIOR COMMERCIALIZATION EXPERIENCE

Table 24: Characteristics of SBV Awardee and Non-participant Firms

Firm Characteristics	All SBV Awardees (n = 61*)	Round 1 Participants (n = 27)	Round 2 Participants (n = 25)	Round 3 Participants (n = 9*)	Non-participants (n = 35)
Age of Firm					
Min	1	1	1	1	0
Max	24	24	18	15	40
Mean	8	13 ^{np}	7	6	8 ¹
Median	6	6	4	4	5
Full Time Employees (FTEs)					
Min	0	0	2	1	0
Max	63	63	42	50	300
Mean	12	13	12	13	15
Median	6	6	9	4	4
Technology Readiness Level (TRL)					
Min	0.0	0.0	2.6	0.0	0.0
Max	9.0	9.0	9.0	9.0	9.0
Mean	6.4	6.3	6.7	5.4	5.6
Median	7.1	7.1	7.1	4.7	7.1

* Firm age, FTE, and TRL application data was only available for nine of the 25 Round 3 awardees.

^{np} Statistically significantly different from non-participants at the 90% confidence level.

¹ Statistically significantly different from Round 1 awardees at the 90% confidence level.

Figure 33: Firms Previous Experience with Commercialization (multiple responses permitted)

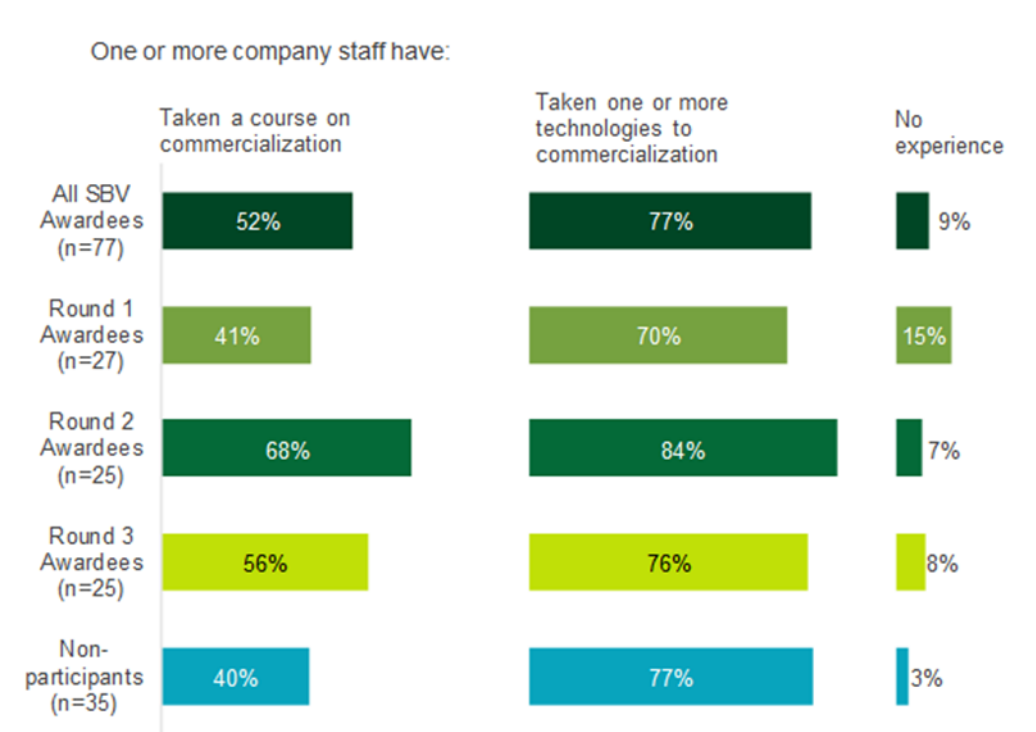


Table 25: Technology Status Questions from SBV Application

SBV Application Question	% Yes, All Awardees (n = 61*)	% Yes, Round 1 (n = 25)	% Yes, Round 2 (n = 25)	% Yes, Round 3 (n = 9*)	% Yes, Non-participants (n = 35)
Have you demonstrated the feasibility of the technology in the lab?	95%*	92%	100% ^{np}	89%	83%*, ²
Have you created and tested (or are in the process of testing) a prototype?	84%	88%	80%	78%	77%
Have you demonstrated/Are you currently demonstrating the product/service in an initial pilot project or demonstration?	57%	56%	64%	44%	54%
Have you achieved sales – more than one – and are actively seeking more sales?	36%	32%	44%	22%	26%

* Technology status application data was only available for nine of the 25 Round 3 awardees.

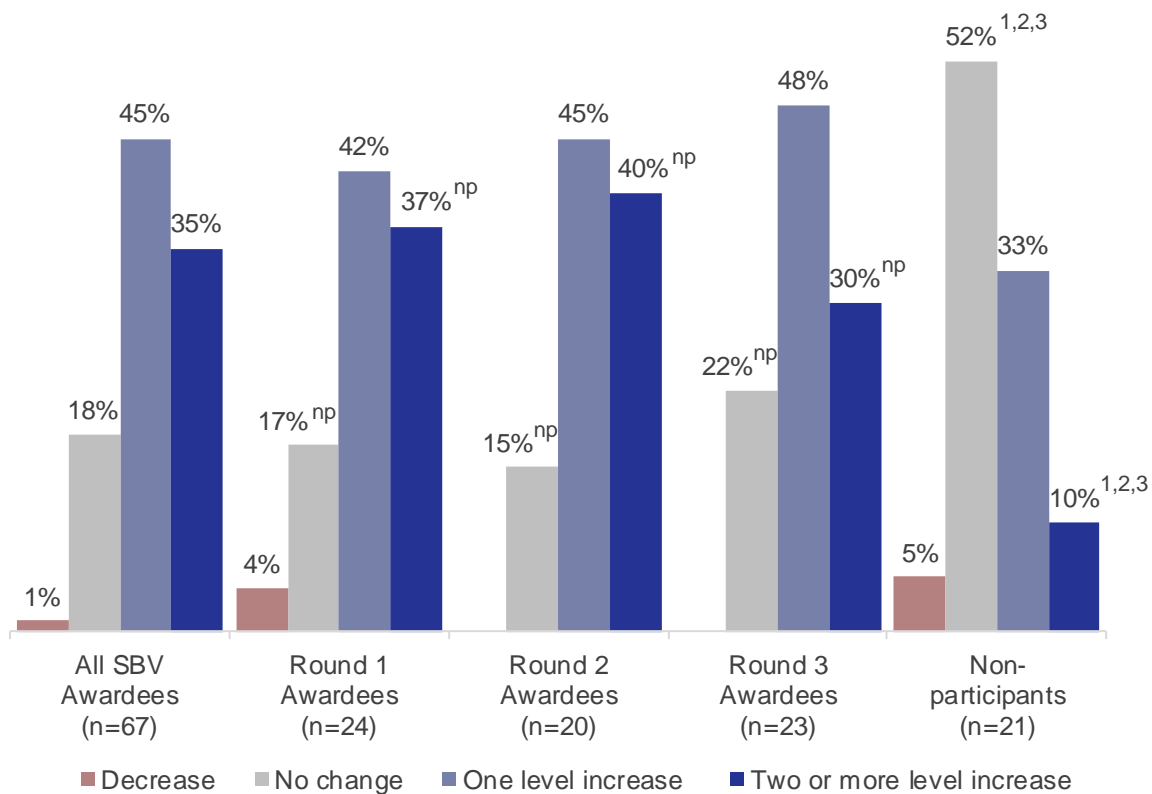
^{np} Statistically significantly different from non-participants at the 90% confidence level.

² Statistically significantly different from Round 2 awardees at the 90% confidence level.

C.2 COMMERCIALIZATION ASSISTANCE

C.2.1 Advancement of Technology Readiness Levels

Figure 34: Change in Stage of Development



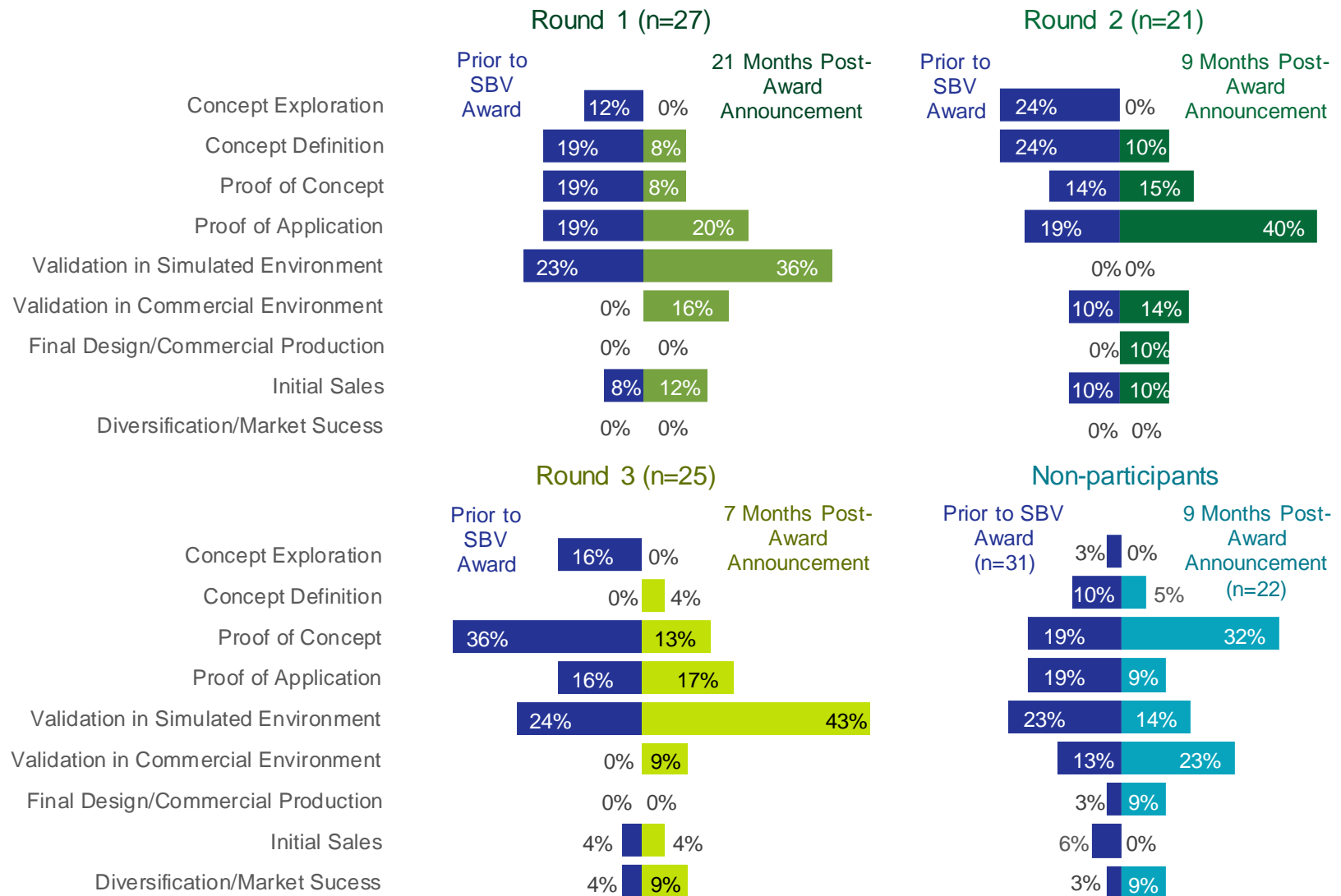
^{np} Statistically significantly different from non-participants at the 90% confidence level.

¹ Statistically significantly different from Round 1 awardees at the 90% confidence level.

² Statistically significantly different from Round 2 awardees at the 90% confidence level.

³ Statistically significantly different from Round 3 awardees at the 90% confidence level.

Figure 35: Awardee Stage of Development Before and After SBV Award



*The Round 2 participant survey erroneously repeated stage 6 “Validation in commercial operational environment/commercial scale,” so the team does not have data on stage 5 “Validation in simulated operation environment/prototype project” for Round 2 awardees.

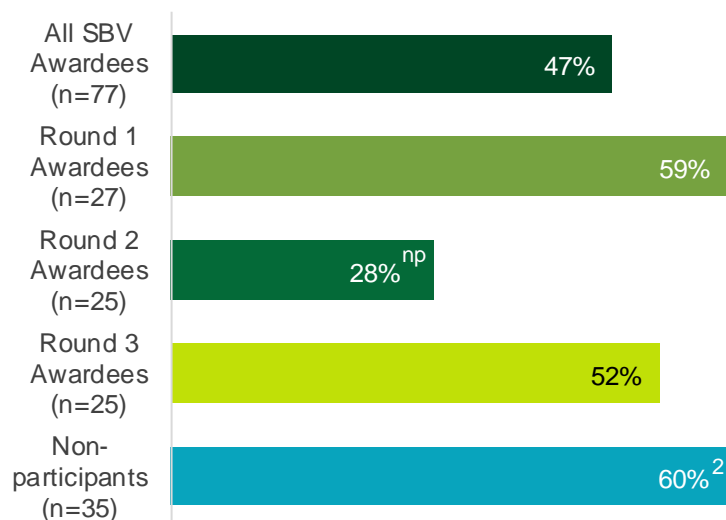
Table 26: Awardee Stage of Development Before and After SBV Award

Stage of Development/ Commercialization	R1		R2		R3		Non-participants	
	Time of SBV Award (n =26)	Post Award (n =25)	Time of SBV Award (n =21)	Post Award (n =20)	Time of SBV Award (n =25)	Post Award (n =23)	Time of SBV Award (n = 38)	Post Award (n = 22)
Conceptualization and proof of concept (1 to 4)	69%	36%	81%*	65%	68%	35%	52%* ²	45%
Validation stages (5 & 6)	23%	52%	10%*	14%*	24%	52%	35%* ²	36%* ²
Commercialization stages (7 to 9)	8%	12%	10%	20%	8%	13%	13%	18%
Average	3.6*	4.9	3.2*	4.7	3.8	5.0	4.5* ^{1 2}	4.9

* Statistically significantly different at the 90% confidence level.

C.2.2 Follow-on Funding and Sales

Figure 36: Percent of Respondents that Received or Invested Additional Development Funding



^{np} Statistically significantly different from non-participants at the 90% confidence level.

² Statistically significantly different from Round 2 awardees at the 90% confidence level.

Table 27: Distribution of Total Additional Funding by Source

	All SBV Awardees (n = 32)	Round 1 Awardees (n = 15)	Round 2 Awardees (n = 6)	Round 3 Awardees (n = 11)	Non-participants (n = 18)
Private Investment	88%	84%	98%	50%	34%
Federal non-SBV	6%	10%	2%	17%	21%
Firm's Funds (including loans)	3%	4%	0%	22%	9%
State or Local Government	1%	2%	0%	4%	28%
Personal Funds	1%	1%	0%	7%	5%
College or Universities	0%	0%	0%	0%	4%

Table 28: Received Additional Funding by Technology Type

Technology Type	Awardees (n = 77)	Non-participants (n = 35)
Technical process development, data modeling, and system design (software)	36%	38%
System design, materials testing, and manufacturing (hardware)	64%	63%

Figure 37: Estimated Amounts of Follow-on Funding Received, All Sources

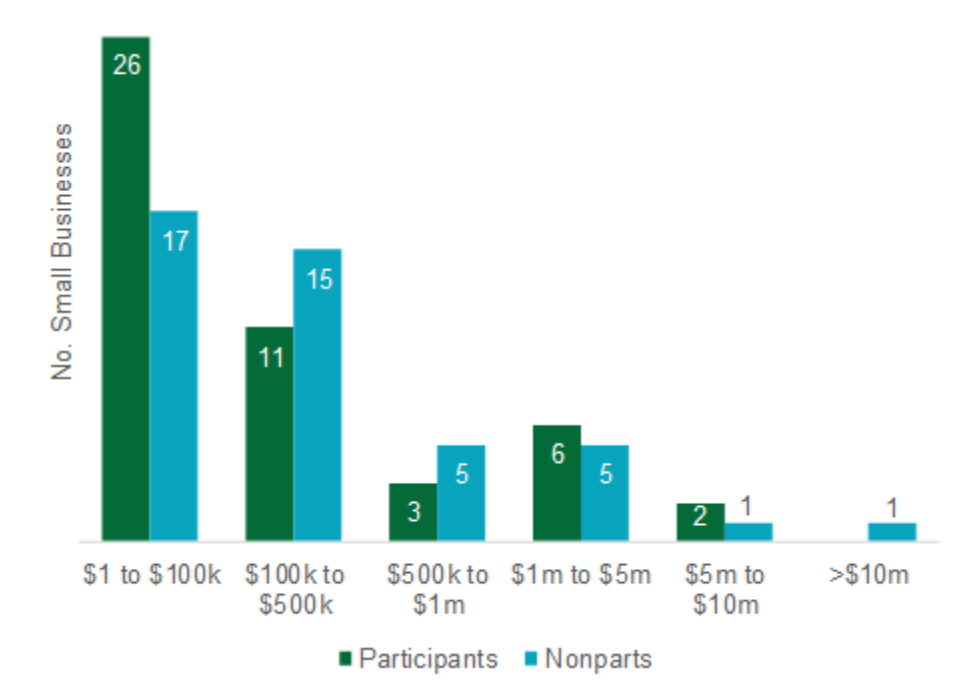
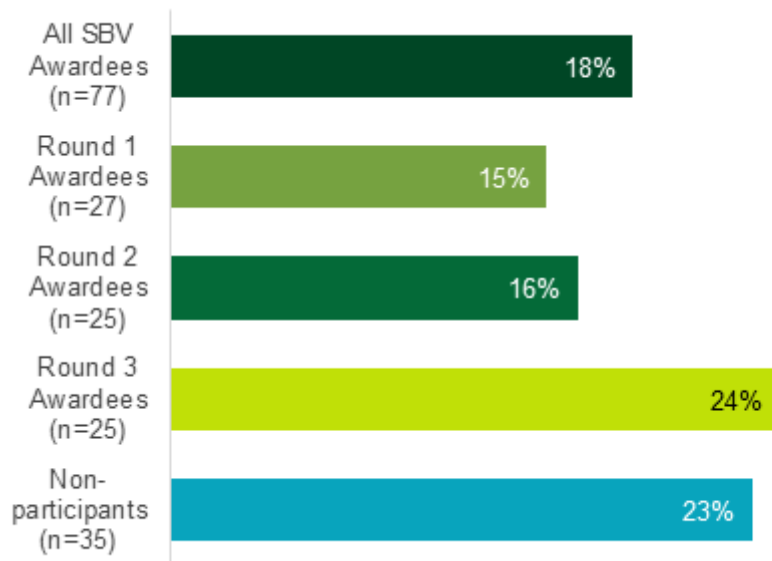
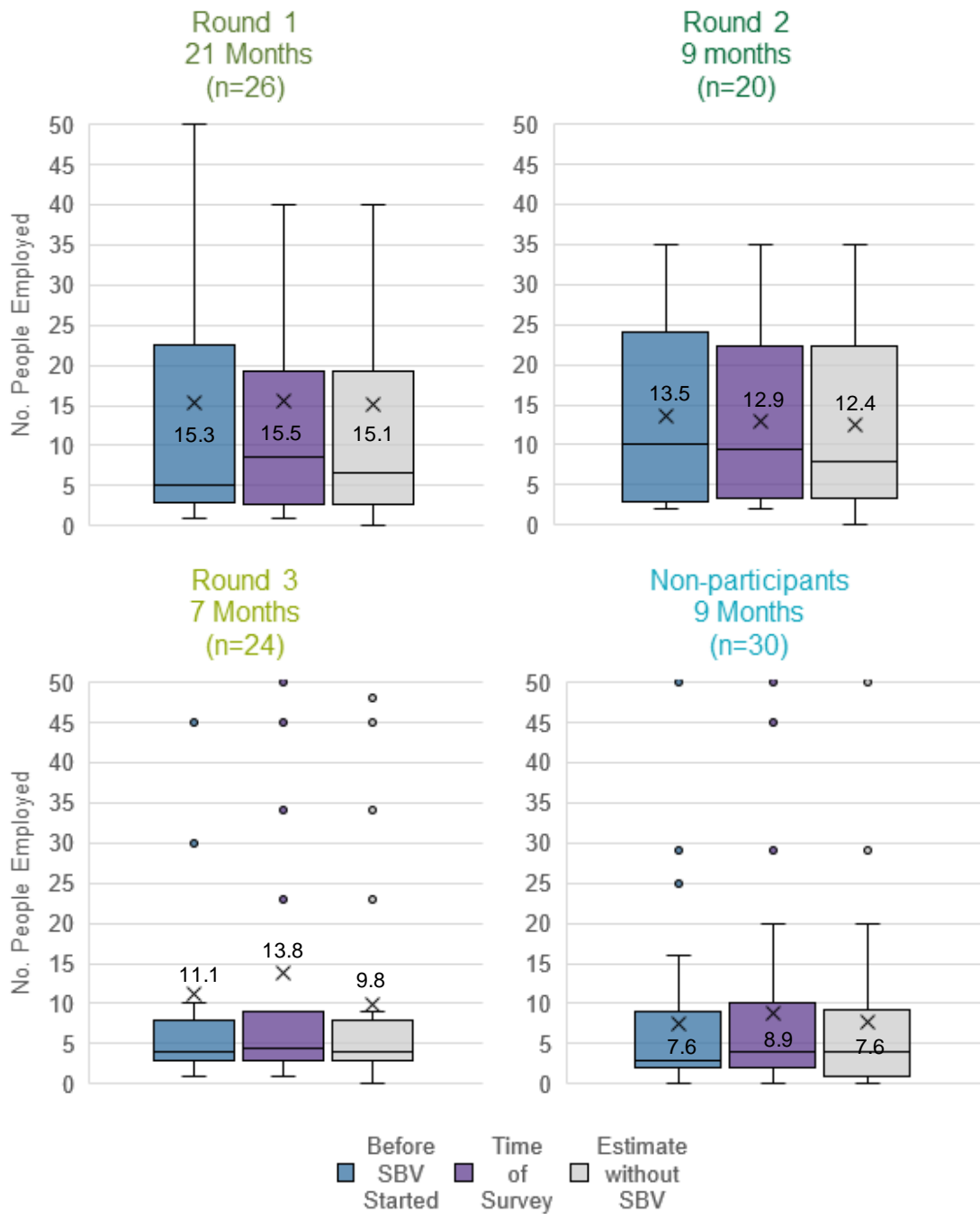


Figure 38: Percent of Respondents Reporting Sales Since the Award Announcement/Applying to SBV



C.2.3 Employment Effects

Figure 39: Number Employed at Respondent’s Firm Before and After Training



*X represents the mean.

Figure 40: Sales of Products, Services, Process(es), or Other Sales

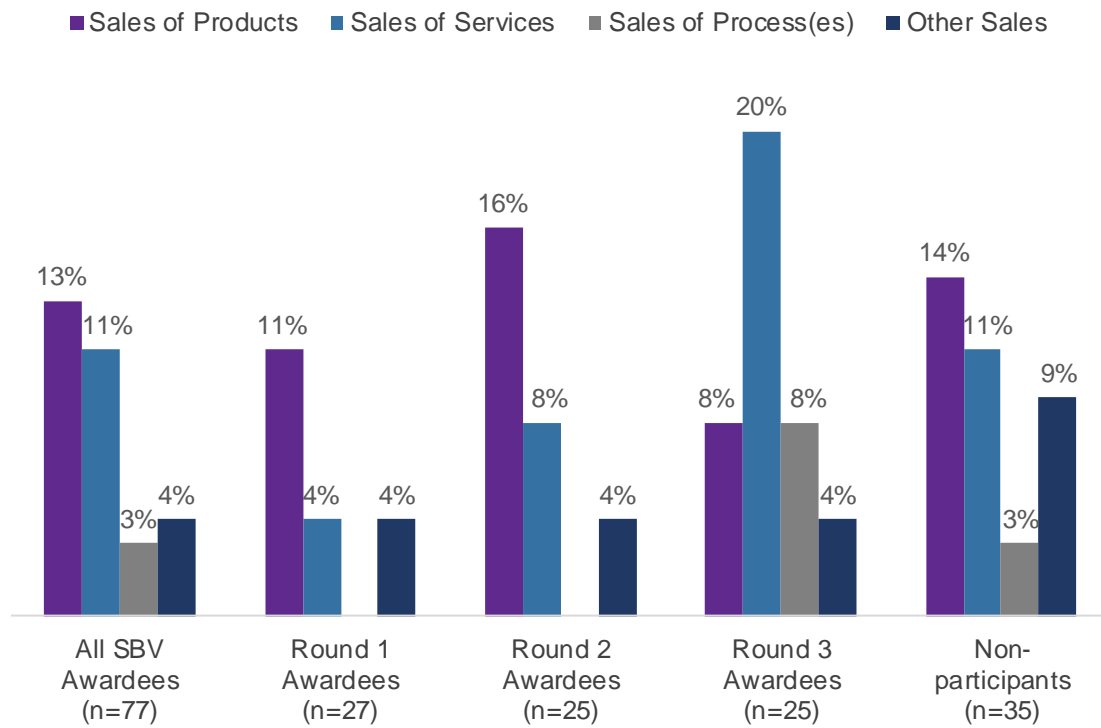
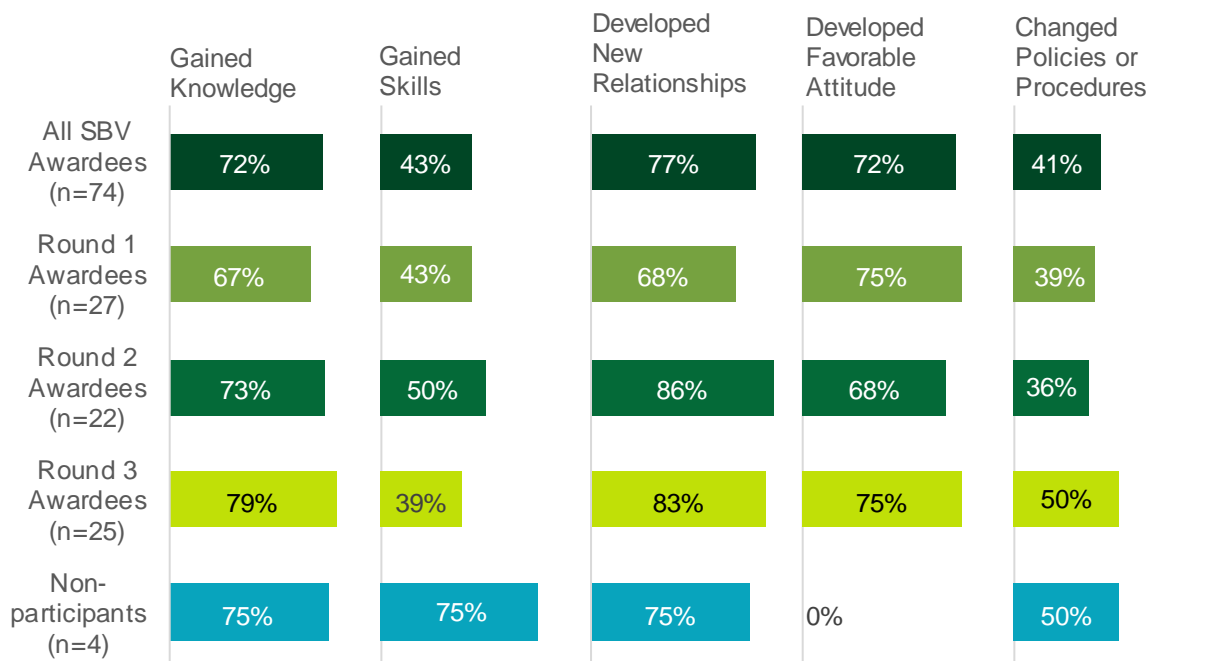


Table 29: Sales by Technology Type

Technology Type	Awardees (n =68)	Non-participants (n = 29)
Technical process development, data modeling, and system design (software)	39%	48%
System design, materials testing, and manufacturing (hardware)	61%	52%

C.2.4 Other Considerations

Figure 41: New Knowledge, Skills and Relationships through Conducting the SBV Project/Cooperative Assistance from the Labs*



*Percent four or five on a five-point scale, where one is *not at all* and five is *a great deal*.

Table 30: Number of Patents, Copyrights, Trademarks, and/or Scientific Publications Applied for/Submitted

Number Applied for/Submitted	All SBV Awardees (n=52)		Round 1 (n=21)		Round 2 (n=13)		Round 3 (n=18)		Non-participants (n=21)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Patents	0-3	0.2 ^{np}	0-1	0.1 ^{np}	0-0	0.0 ^{np}	0-3	0.3 ^{np}	0-6	1.7 ^{1,2,3}
Copyrights	0-0	0.0	0-0	0.0	0-0	0.0	0-0	0.0	0-4	0.2
Trademarks	0-0	0.0	0-0	0.0	0-0	0.0	0-0	0.0	0-10	1.1
Scientific/Technical Publications	0-5	0.2 ^{np}	0-1	0.2 ^{np}	0-1	0.1 ^{np}	0-5	0.4 ^{np}	0-5	1.6 ^{1,2,3}

^{np} Statistically significantly different from non-participants at the 90% confidence level.

¹ Statistically significantly different from Round 1 awardees at the 90% confidence level.

² Statistically significantly different from Round 2 awardees at the 90% confidence level.

³ Statistically significantly different from Round 3 awardees at the 90% confidence level.

Table 31: Number of Patents, Copyrights, Trademarks, and/or Scientific Publications Received/Published

Number Received/Published	All SBV Awardees (n=32)		Round 1 (n=15)		Round 2 (n=8)		Round 3 (n=9)		Non-participants (n=13)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Patents	0-1	0.0 ^{np}	0-0	0.0 ^{np}	0-1	0.1 ^{np}	0-0	0.0 ^{np}	0-4	0.8 ^{1,2,3}
Copyrights	0-0	0.0	0-0	0.0	0-0	0.0	0-0	0.0	0-1	0.1
Trademarks	0-0	0.0	0-0	0.0	0-0	0.0	0-0	0.0	0-10	1.4
Scientific/Technical Publications	0-5	0.3 ^{np}	0-3	0.3 ^{np}	0-1	0.1 ^{np}	0-5	0.6	0-4	1.4 ^{1,2}

^{np} Statistically significantly different from non-participants at the 90% confidence level.

¹ Statistically significantly different from Round 1 awardees at the 90% confidence level.

² Statistically significantly different from Round 2 awardees at the 90% confidence level.

³ Statistically significantly different from Round 3 awardees at the 90% confidence level.

Table 32: Initial Public Offerings, Spin Offs, and Mergers

	All SBV Awardees (n = 75)	Round 1 Awardees (n = 27)	Round 2 Awardees (n = 23)	Round 3 Awardees (n=25)	Non-participants (n=31)
Planning to make an initial public offering within a year	1%	0% ^{np}	0% ^{np}	4%	10% ^{1,2}
Established one or more spin off companies	1%	0%	0%	4%	6%
Been acquired by/merged with another firm	3%	7%	0%	0%	3%
Made an initial public offering	0%	0%	0%	0%	0%

^{np} Statistically significantly different from non-participants at the 90% confidence level.

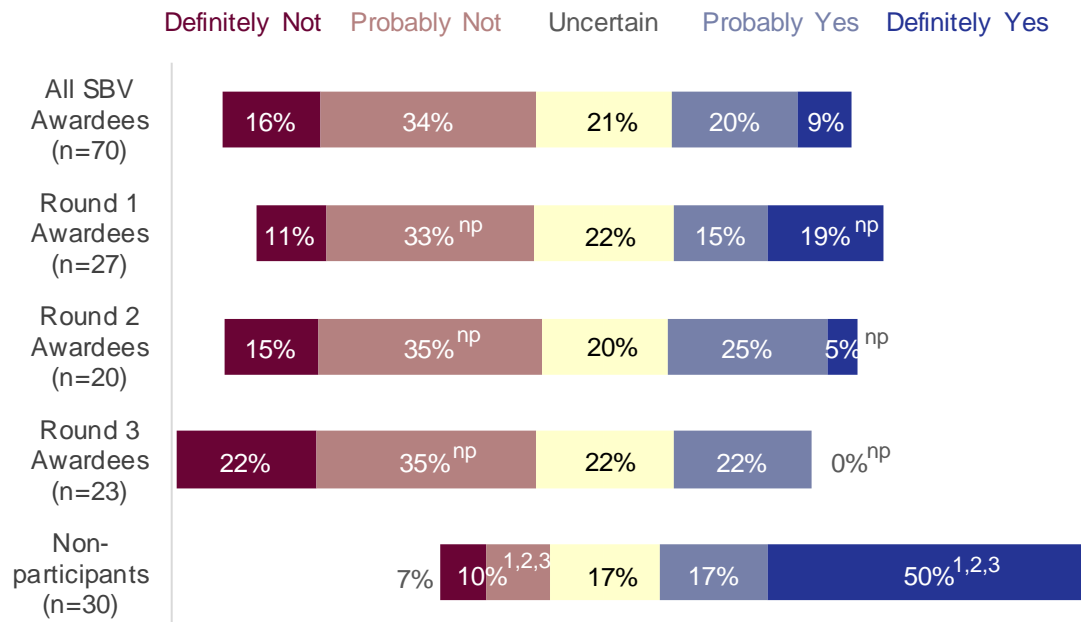
¹ Statistically significantly different from Round 1 awardees at the 90% confidence level.

² Statistically significantly different from Round 2 awardees at the 90% confidence level.

Table 33: Description of Changes Experienced through Conducting the SBV Project/Cooperative Assistance from the Labs/Lab CRADA

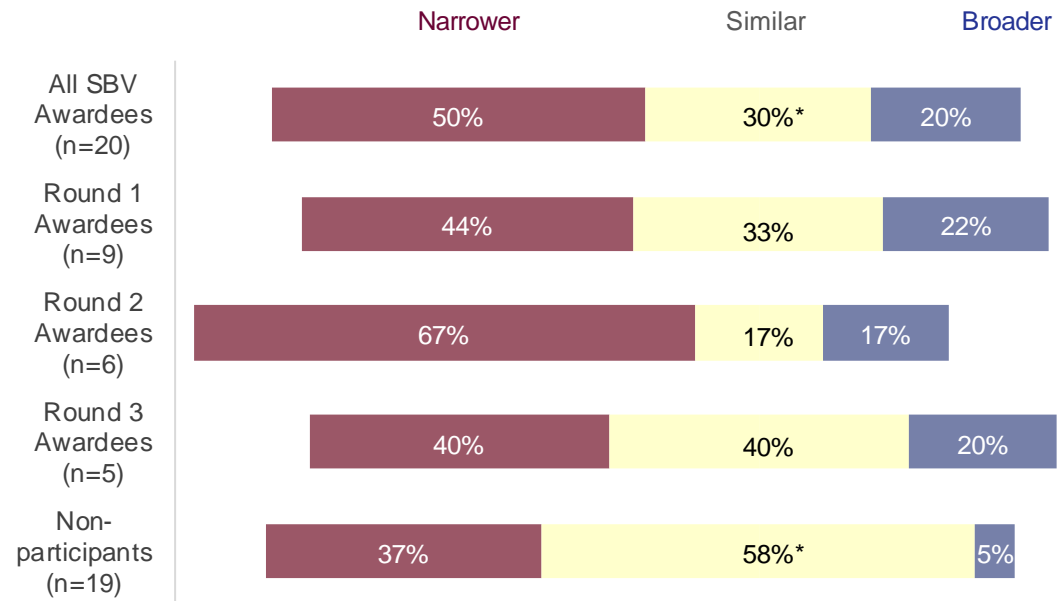
	All SBV Awardees	Round 1 Awardees	Round 2 Awardees	Round 3 Awardees	Non-participants
Types of Knowledge Gained					
<i>n</i>	49	18	13	18	2
Technical/Scientific Knowledge	82%	83%	85%	78%	50%
Awareness of Lab Facilities	14%	11%	8%	22%	0%
Business Knowledge	4%	6%	8%	0%	50%
Types of Skills Gained					
<i>n</i>	33	11	9	13	0
Technical/Scientific Skills	64%	64%	56%	69%	0%
Collaboration Skills	24%	18%	22%	31%	0%
Business Skills	12%	18%	22%	0%	0%
Types of Changes in Attitudes					
<i>n</i>	37	12	11	14	0
Changed Opinion of Lab Staff Expertise/Facilities	92%	100%	73%	100%	0%
Encountered Bureaucratic Challenges	8%	0%	27%	0%	0%
Types of Changes in Policies or Procedures					
<i>n</i>	10	1	5	4	0
Will Seek Additional Opportunities to Work with Labs	100%	100%	100%	100%	0%

Figure 42: Project Status in the Absence of the SBV Award or Applying for the SBV Award



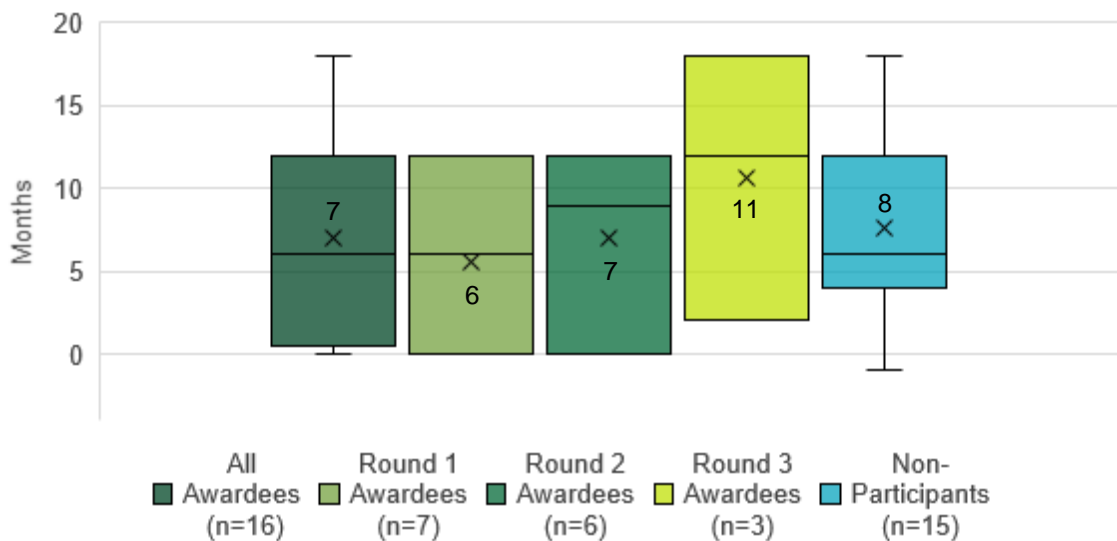
^{np} Statistically significantly different from non-participants at the 90% confidence level.
¹ Statistically significantly different from Round 1 awardees at the 90% confidence level.
² Statistically significantly different from Round 2 awardees at the 90% confidence level.
³ Statistically significantly different from Round 3 awardees at the 90% confidence level.

Figure 43: Estimated Scope of Project if Undertaken in Absence of SBV Award or Applying for SBV Award



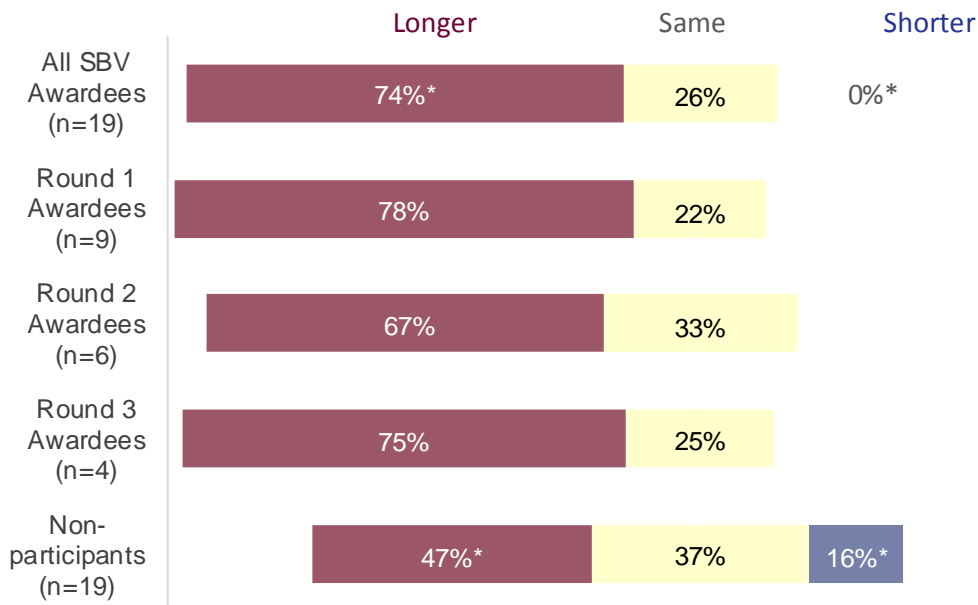
*Statistically significantly different at the 90% confidence level.

Figure 44: Estimated Delay if Undertaken in Absence of SBV Award or Applying for SBV Award



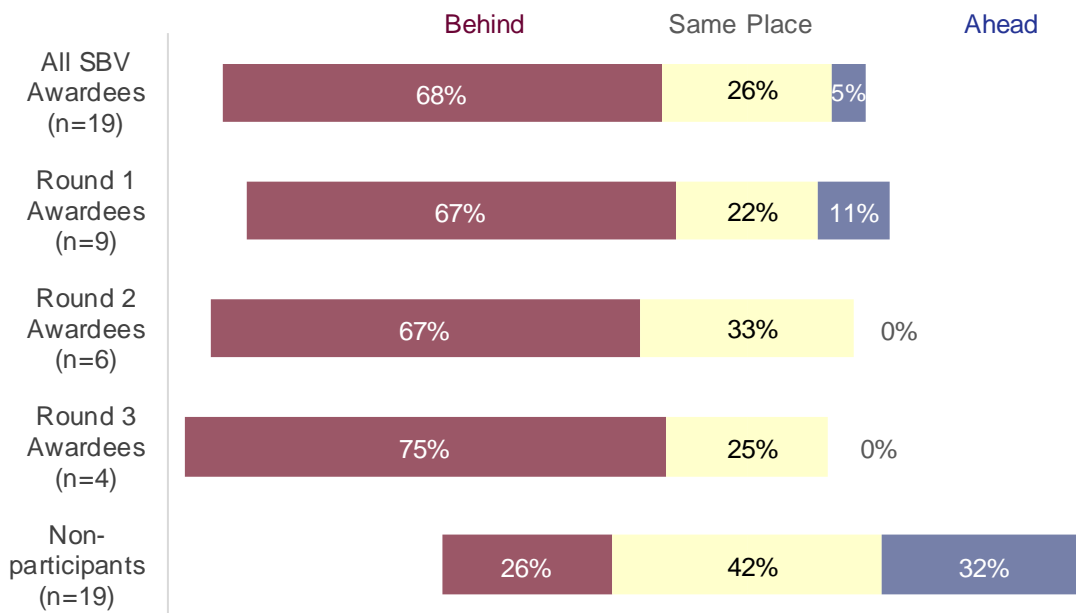
*X represents the mean.

Figure 45: Estimated Time to Completion of Project if Undertaken in Absence of SBV Award or Applying for SBV Award



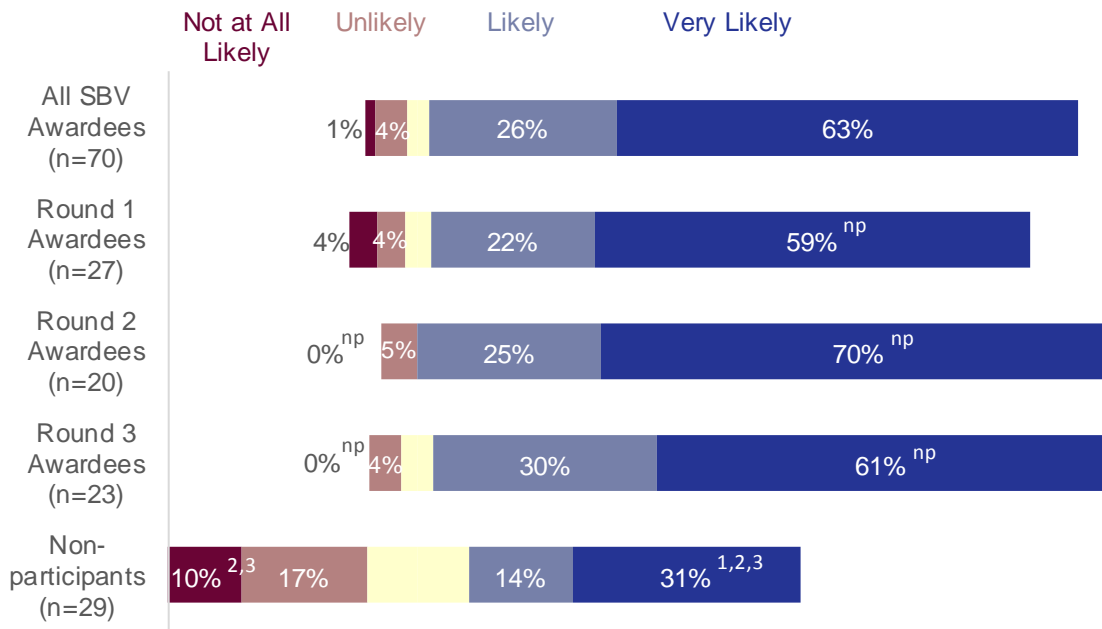
*Statistically significantly different at the 90% confidence level.

Figure 46: Estimated Progress Towards Milestones of Project if Undertaken in Absence of SBV Award or Applying for SBV Award



C.3 ENGAGEMENT WITH SMALL BUSINESSES

Figure 47: Likelihood that You Will Work with the Labs Again



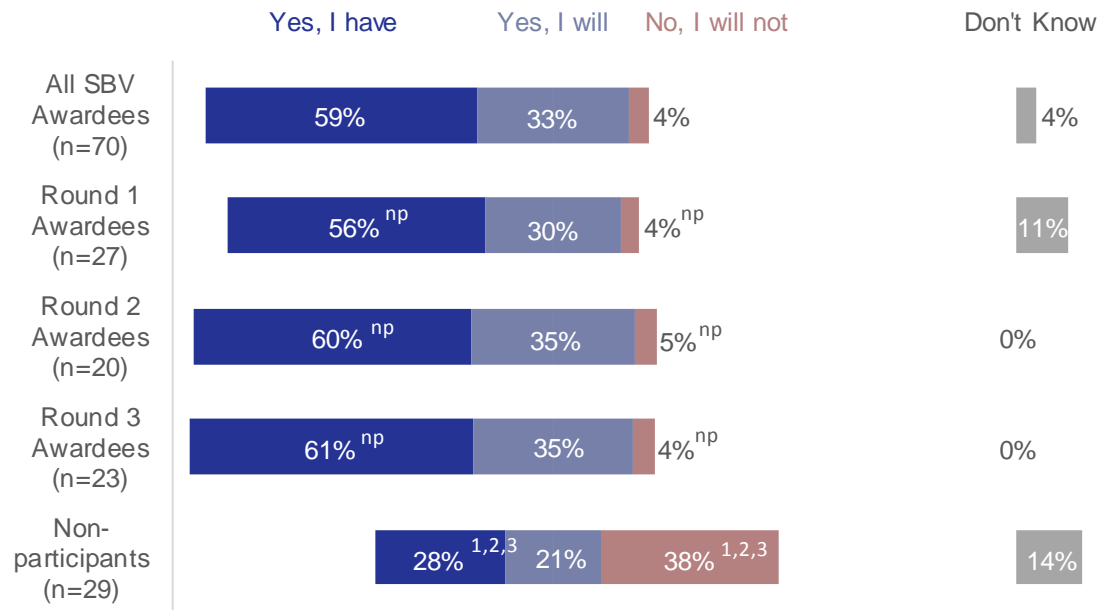
^{np} Statistically significantly different from non-participants at the 90% confidence level.

¹ Statistically significantly different from Round 1 awardees at the 90% confidence level.

² Statistically significantly different from Round 2 awardees at the 90% confidence level.

³ Statistically significantly different from Round 3 awardees at the 90% confidence level.

Figure 48: Respondent Recommendations to Colleagues or Other Small Businesses that they Work with the Labs



^{np} Statistically significantly different from non-participants at the 90% confidence level.
¹ Statistically significantly different from Round 1 awardees at the 90% confidence level.
² Statistically significantly different from Round 2 awardees at the 90% confidence level.
³ Statistically significantly different from Round 3 awardees at the 90% confidence level.

Figure 49: Extent to which Awardee Expectations Were Met by the Following Aspects of the Voucher Application Process and the Funding Opportunity Notice

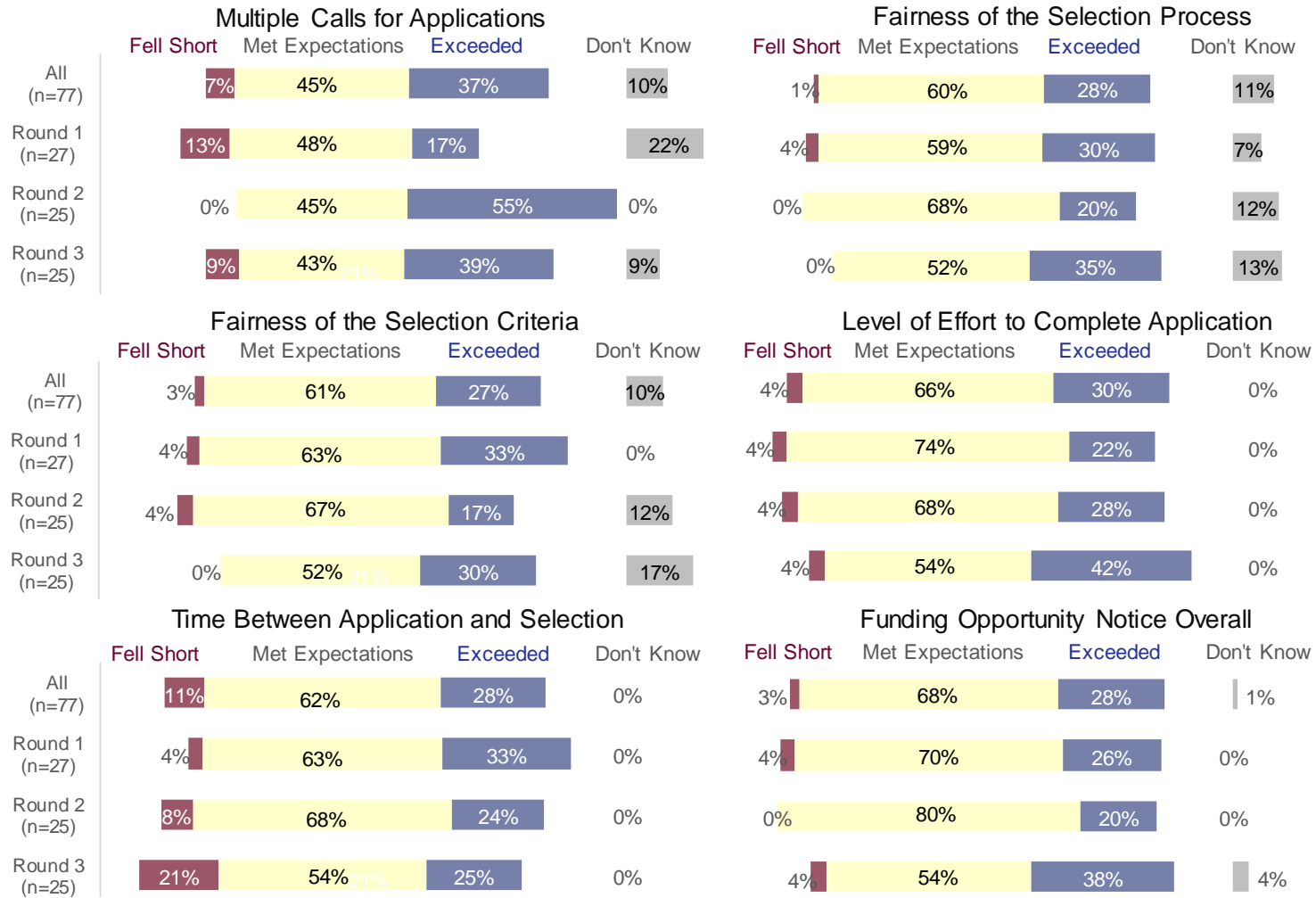


Figure 50: Extent to which Awardee Expectations Were Met by the Following Aspects of Project

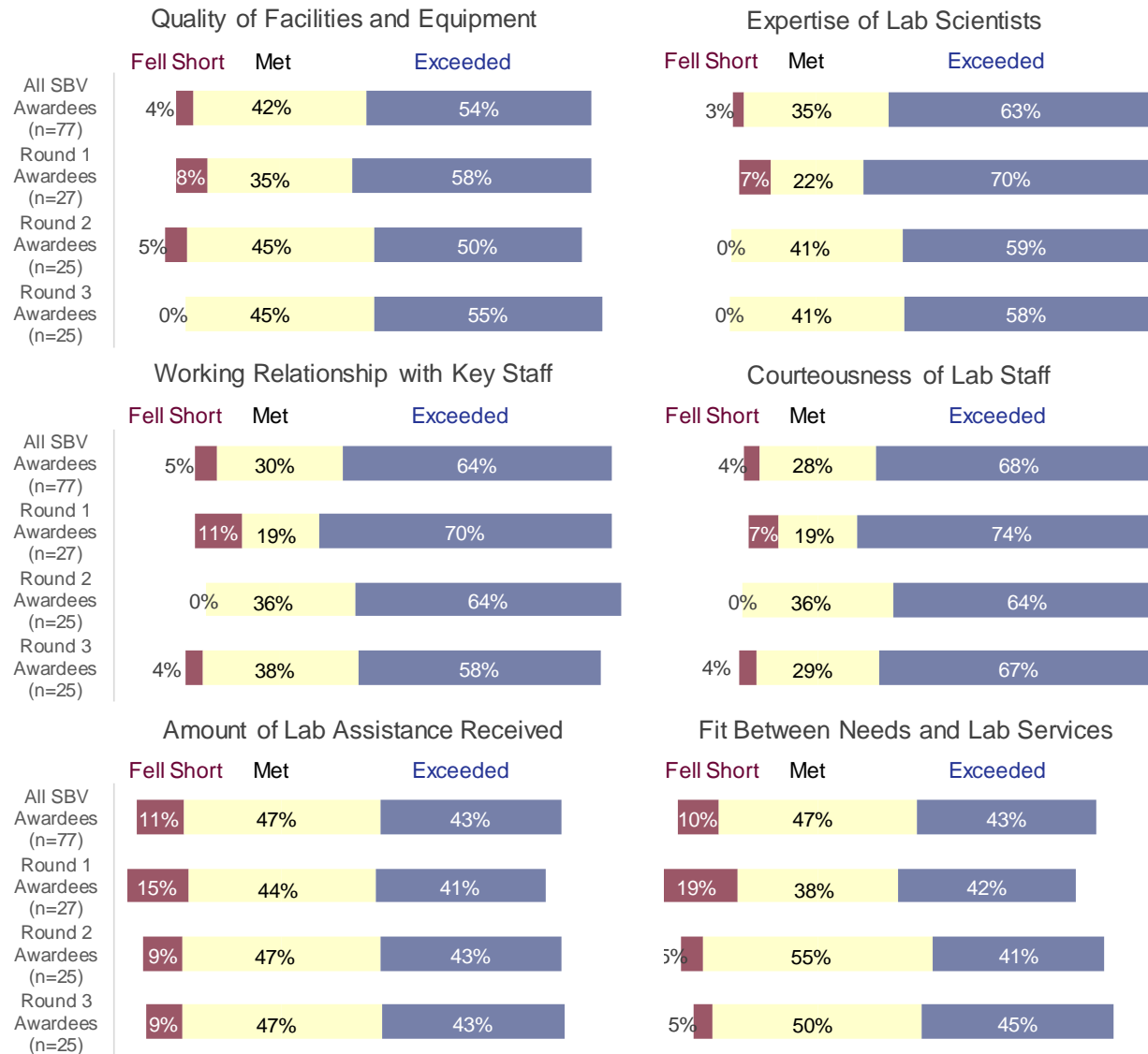


Figure 51: Awardees’ Opinion of the SBV Application Process Compared to Other Federal Awards or Federal Funding

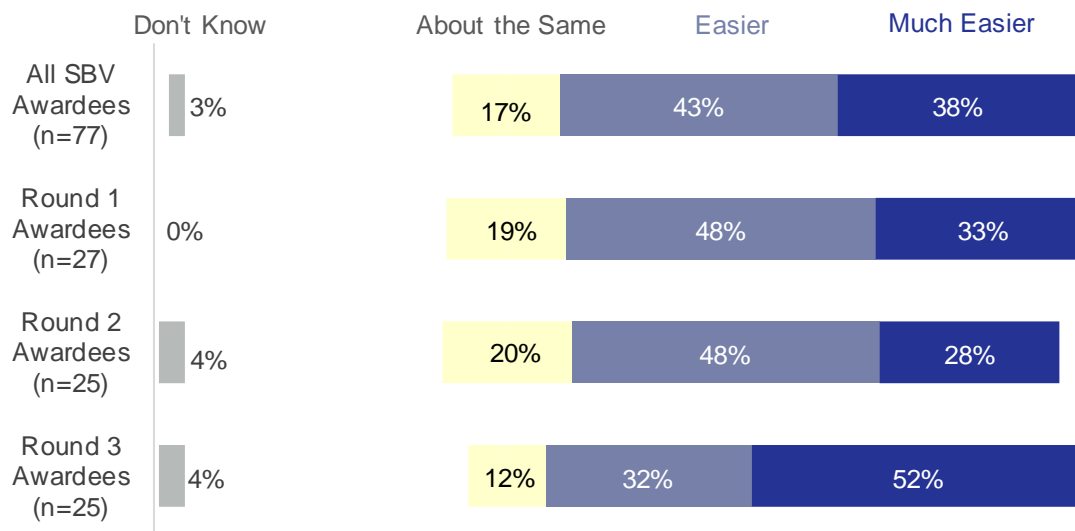


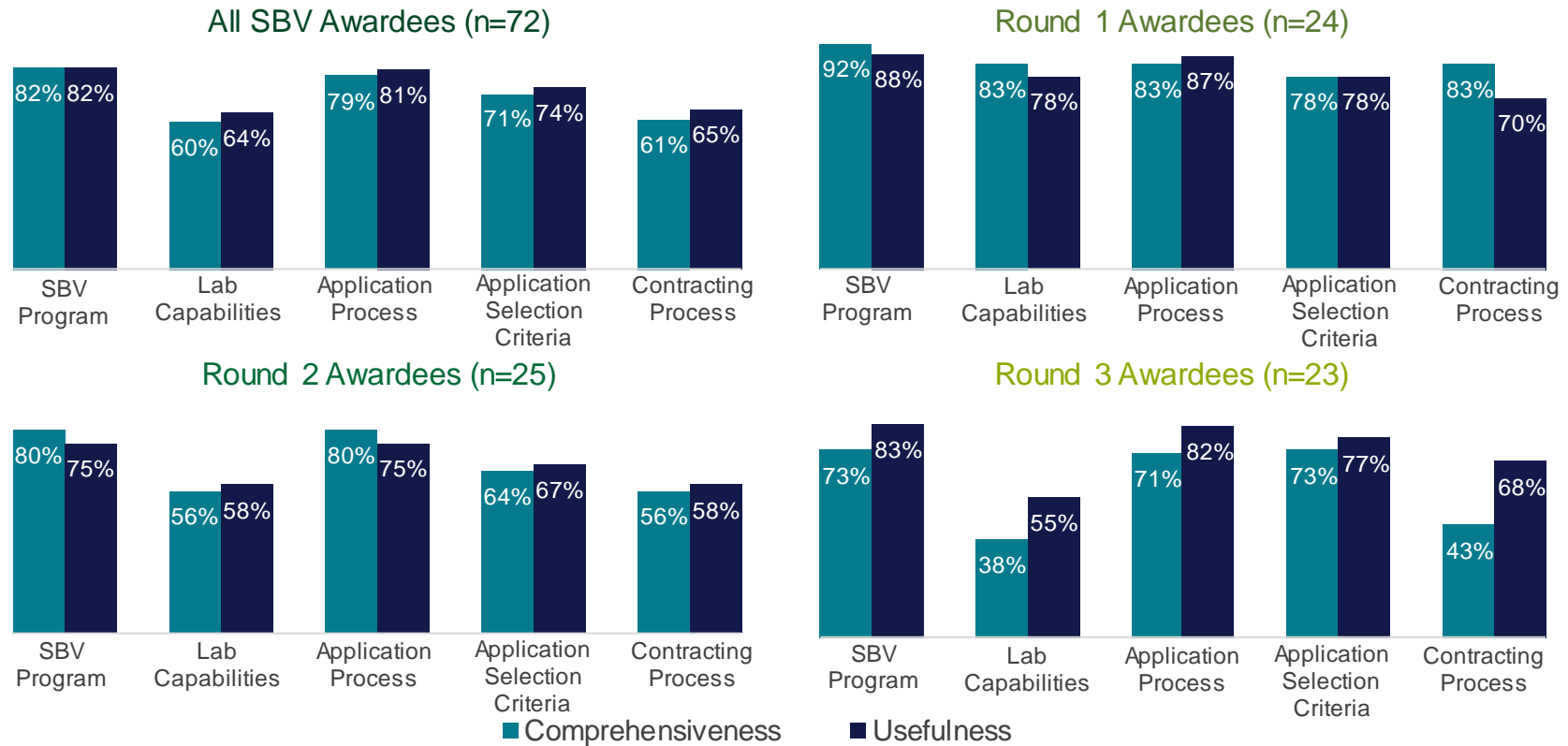
Table 34: Extent to which Expectations Were Met by Aspects of your Firms' SBV Contract and the Associated Statement of Work/Cooperative Assistance from the Lab

Percent Expectations Met or Exceeded	All SBV Awardees (n = 77)	Round 1 Participants (n = 27)	Round 2 Participants (n = 25)	Round 3 Participants (n = 25)	Non-participants (n = 5)
Expertise of Lab staff involved in contracting	99%	96%	100%	100%	100%
Courteousness of Lab staff involved in contracting	97%	93%	100%	100%	100%
Definition of tasks	95%	93%	96%	96%	100%
Treatment of proprietary information, confidentiality	93%	96%	96%	88%	60%
Contract and Statement of Work process overall	92%	93%	87%	96%	80%
Definition of task outcomes or milestones	91%	85%	92%	96%	100%
Length of time it took to develop the SOW	91%	85%	92%	96%	40%
Understanding of small business needs by Lab staff involved in contracting	88%	81%	92%	92%	80%
Setting of deadlines	84%	81%	87%	84%	80%
Assignment of intellectual property	84%	89%	79%	83%	80%
The Standard contract form and its contents overall	83%	88%	84%	76%	40%

Table 35: Type of Contract or Agreement with Lab

Type of Contract/Agreement	All Awardees (n = 77)	Round 1 Awardees (n = 27)	Round 2 Awardees (n = 25)	Round 3 Awardees (n = 25)	Non-participants (n = 5)
CRADA	78%	67%	84%	84%	80%
TAPA	12%	19%	8%	8%	0%
Both	1%	0%	0%	4%	0%
Don't know/refused	9%	15%	8%	4%	20%
Total	100%	100%	100%	100%	100%

Figure 52: Comprehensiveness and Usefulness of the Topics Addressed on the SBV “Central Assistance Portal”*



*Percent that gave a four or five rating on a five-point scale, where one is *not at all comprehensive/useful* and five is *very comprehensive/useful*.

Figure 53: Sought Information about Energy-Related Technologies, Facilities, or Staff Expertise at any U.S. DOE Laboratory Before SBV Pilot or Application for SBV

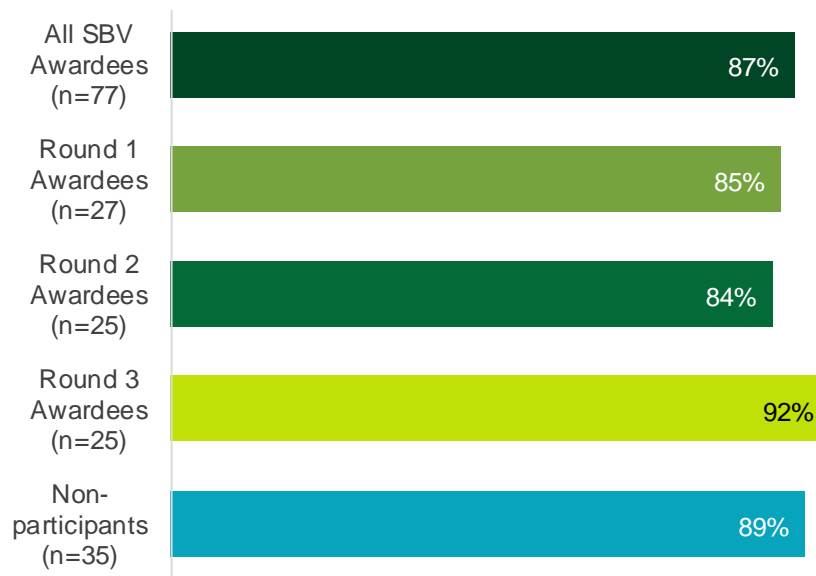


Table 36: Lab Partnership Before SBV Award or Application to SBV (multiple responses permitted)

Partnership Type	All SBV Awardees (n = 77)	Round 1 Participants (n = 27)	Round 2 Participants (n = 25)	Round 3 Participants (n = 25)	Non-participants (n = 35)
SBIR	36%	37%	33%	44%	30%
CRADA	29%	26%	25%	40% ^{np}	19% ³
Technology Licensing Agreement	17%	15%	24%	16%	17%
Technical Assistance Program	17%	19%	27%	8%	13%
WFO	17%	26%	5%	20%	11%
User Agreements	8%	7%	5%	12% ^{np}	0% ³
ACT	1%	4%	0%	0%	7%
Other Type of Partnership	14%	15% ^{np}	36%	12% ^{np}	35% ^{1,3}
No Prior Partnerships	9%	7%	23%	8%	17%

^{np} Statistically significantly different from non-participants at the 90% confidence level.

¹ Statistically significantly different from Round 1 awardees at the 90% confidence level.

³ Statistically significantly different from Round 3 awardees at the 90% confidence level.

Table 37: How You/Your Firm Learned About the Earlier Lab Partnership Opportunity (multiple responses permitted)

Source	All SBV Awardees (n = 64)	Round 1 Participants (n = 20)	Round 2 Participants (n = 25)	Round 3 Participants (n = 19)	Non-participants (n = 21)
Outreach from Lab staff (personal or an event)	70%	70%	89%	74%	75%
Press releases from U.S. Department of Energy	50%	40%	58%	68%	47%
Press releases from an individual National Lab	19%	15%	21%	26%	19%
Outreach from an energy-efficiency or renewable energy program	17%	20%	11%	26%	25%
From a friend or another small business	16%	0% ^{np}	21%	32%	25% ¹
Outreach from another small business support program or effort	9%	10%	16%	5%	7%
Media (newspaper stories, radio, television, internet)	6%	5%	5%	11%	12%
Other	5%	10%	5% ^{np}	0% ^{np}	25% ^{2,3}

^{np} Statistically significantly different from non-participants at the 90% confidence level.

¹ Statistically significantly different from Round 1 awardees at the 90% confidence level.

² Statistically significantly different from Round 2 awardees at the 90% confidence level.

³ Statistically significantly different from Round 3 awardees at the 90% confidence level.

Table 38: How You/Your Firm Learned About SBV (multiple responses permitted)

Source	All SBV Awardees (n = 77)	Round 1 Participants (n = 27)	Round 2 Participants (n = 25)	Round 3 Participants (n = 25)	Non-participants (n = 5)
Outreach from Lab staff (personal or an event)	70%	63%	84%	64%	75%
Press releases from U.S. Department of Energy	53%	37%	71%	64%	60%
From a friend or another small business	22%	4%	42%	32%	25%
Press releases from an individual National Lab	19%	15%	26%	24%	25%
Outreach from an energy-efficiency or renewable energy program or effort	16%	11%	15%	24%	50%
Outreach from another small business support program or effort	14%	4%	30%	16%	50%
Media (newspaper stories, radio, television, internet)	8%	7%	11%	8%	0%
Other	4%	7%	11%	0%	0%

DOE/EE Publication Number: 1863