Evaluation of U.S. DOE Small Business Vouchers Pilot

Year 5 Outcomes and Impacts, Round 1, 2, & 3 Awardees

Final Report

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research into action inc

NMR Group, Inc.

Gretchen Jordan, Ph.D.

Albert Link, Ph.D. East Mountain IP

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The evaluation team for this study comprises NMR Group, Inc. (Dr. Greg Clendenning), Research Into Action, Inc. (Dr. Marjorie McRae), and 360 Innovation, LLC (Dr. Gretchen Jordan).

Notice

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Acronyms

ACT	Agreements for Commercializing Technology
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
TA	Technical Assistance
SPP	Strategic Partnership Projects
TAPA	Technical Assistance Pilot Agreement
TRL	Technology Readiness Level
WFO	Work for Others

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	*Small Business Vouchers Pilot Laboratory Call for Proposals,* 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 *TRL*, is a widely-used indicator of degree of development of a technology toward validation at commercial scale in the actual operating environment; degree of development is described on a scale of 1-9, with 9 being fully deployment ready.
Technology Transfer	The process by which technology or knowledge developed in one place or for one purpose is applied and used in another place for the same or different purpose.
Technology Offices (also known as Program Offices)	EERE develops research agendas and directs and funds research through its Technology Offices: Advanced Manufacturing Office (AMO), Bioenergy Technologies Office (BETO), Building Technologies Office (BTO), Fuel Cells Technology Office (FCTO), Geothermal Technologies Office (GTO), Solar Energy Technology Office (SETO), Vehicle Technologies Office (VTO), Water Power Technologies Office (WPTO), and Wind Energy Technologies Office (WETO).

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 is the culmination of five years of evaluations of the SBV pilots. We present the most recent evaluation findings of outcomes and impacts evidenced by awardees through August 2019, ranging from 28 to 42 months from award announcement. We also present a summary of key findings reported in previously published reports.

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.

This report presents findings from the most recent wave of data collection pertaining to the pilot's early stage outcomes and impacts of labs' efforts to address the third goal, commercialization assistance (goal 3); the extent to which SBV technologies reach the commercial market as the initial part of the fourth goal (goal 4); and information to help assess engagement (goal 1). We also present a summary of key findings from previously published reports for goal 1 (lab engagement) and goal 2 (lab awareness).[2]

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

[2] Key findings from previous reports summarized here are limited to metrics for which new data were not collected for this report. See Research Into Action, NMR and Gretchen Jordan. 2016. Baseline and Process Evaluation of Small

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 several metrics to assess commercialization assistance and success. For most metrics, this study also compares SBV awardees with comparable SBV applicants who did not receive awards (termed non-participants). The metric technology readiness level (TRL)[5] is used to assess small business success in solving their technology problems. In addition to TRL advancement, which is the key outcome of the lab-provided assistance for goal 3, the study reports on several other metrics, including the following, organized by SBV goals:

- Goal 3: Commercialization Assistance
    - follow-on funding (an anticipated early outcome)
    - market pivot – whether awardees have pivoted to new markets and the role of SBV in that pivot
    - intellectual property created (e.g., patents)
- Goal 4: Commercialization Success
    - market use for the technology - whether the technology is being used in the market and has achieved sales (an anticipated mid-term outcome)

Business Vouchers Pilot. DOE/EE-1574. SBV Baseline and Process Evaluation. Statistics presented here are updated to include all three rounds.
Research Into Action, NMR and Gretchen Jordan. 2018. Early Stage Outcomes and Impacts, Round 1, 2, & 3 Awardees DOE/EE-1576. Early Stage Outcomes Evaluation.

[3] For example, see the overview description of SBV, which indicates that the pilot will help small businesses "*overcome critical technology and commercialization challenges"* https://www.sbv.org/pdfs/sbv-notice-of-opportunity-rfa.pdf

[4] For example, see 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
Another key factor is the policy and regulatory environment within which commercialization efforts operate (for example, see Bozeman's three technology policy paradigms: Bozeman, B., 2000. Technology transfer and public policy: a review of research and theory. *Research Policy 29* (4) 627-655).

[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 corresponds to 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 phase. Additional idiosyncratic differences may exist among the developmental activities for technologies at a given TRL.

- small business development and job creation

STUDY METHODS AND LIMITATIONS

The current 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. The evaluation team conducted the Round 1 survey 42 months after the announcement of the Round 1 awards, the Round 2 survey 36 months after the Round 2 award announcement, and the Round 3 survey 28 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, though we also note that there are limitations to using non-participants as a comparison group.[7] Awardees and non-participants did not statistically significantly vary in their RFA merit review scores, RFA-reported TRLs, technology type,[8] firm age, number of employees, or current involvement with their SBV technology. We did find that non-participants were statistically significantly more likely to have prior commercialization experience (100% of the surveyed non-participants had prior commercialization experience compared to 86% of awardees),[9] while Round 2 and 3 awardees were more likely, relative to non-participants, to have demonstrated the feasibility of their technology in the lab prior to SBV (100% compared to 83%, statistically significant differences).

The evaluation team notes a study limitation: we obtained a small non-participant sample of 18, and awardee sample of 50, despite multiple contacts and reminders sent by email and phone to encourage participation in the study. The small sample sizes limit the statistical analysis we can conduct and reduces the likelihood of detecting differences between the study groups. Both awardees and non-participants had response rates over 50% (65% and 51%, respectively). The small sample sizes encountered in this study reduce the likelihood of detecting differences in outcomes that may exist but for which we lack the statistical power to detect.

A second limitation is that of identifying a credible comparison group. The initial five year evaluation plan cautioned that there would be challenges in establishing a credible comparison group, especially given the expected variation in voucher firms and technologies addressed in projects and the complexity of any innovation and adoption context. While we use non-participants as a comparison group, the variation noted makes it very difficult to find comparison groups that are similar and remain similar over a period of time.

The non-participant sample is likely characterized by response bias. The evaluation team believes 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 believes non-response

[6] The survey was administered from August to November 2019.

[7] This is similar to our comparison of the participants and non-participants from the previous report. See Research Into Action, NMR and Gretchen Jordan. 2018. Early Stage Outcomes and Impacts, Round 1, 2, & 3 Awardees DOE/EE-1576. Early Stage Outcomes Evaluation

[8] 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.

[9] We note that there were no differences in commercialization experience in the prior report.

bias has likely led to the appearance that some non-participant outcomes are better on average than some of the outcomes for the non-participant population.

FINDINGS

Key Results

Evaluation findings spanning three evaluation reports provide evidence that the SBV pilot achieved its four goals.[10] However, we note that the evidence for goal 3 (commercialization assistance) and goal 4 (commercialization success) is more mixed. We have relatively strong evidence from the perspective of the participants and self-reported attribution to SBV impacts, but we have weaker statistical evidence when we include analysis with a comparison group (i.e., due in part to a small sample of responding non-participants).

We found that the pilot reached its goal of increasing small business engagement with the labs (goal 1) and increasing lab awareness of small business needs (goal 2), as evidenced by the lab's extensive outreach in support of the pilot, lab engagement with thousands of small businesses – the majority of which had not previously worked with the labs, and extremely high levels of awardee satisfaction with all elements of the pilot and interest in continuing to work with the labs (generally over 90%) (see Table 1 and Appendix D).

We find a mix of strong and weak evidence of successful lab commercialization assistance (goal 3) and early stage outcomes of commercialization success (goal 4). With the technical assistance provided by the labs, the vast majority of awardees (86%) reported that their technology had advanced at least one stage of development, but this change is not statistically significantly different from non-participants. However, statistically significantly higher proportions of awardees compared with non-participants reported a change in their technology being used by a market post SBV and their technology being used by the anticipated target market. While similar proportions of awardees and non-participants pivoted to a new market, a statistically significantly higher percentage of awardees attributed SBV with influencing the pivot. Last, while we found evidence that awardees received follow-on funding and developed IP, awardees were not statistically significantly different from non-participants. However, a statistically significantly higher percentage of awardees attributed SBV with influencing the source or amount of follow-on funding.

Regarding commercialization success (goal 4), 30% of awardees achieved sales, though this is not statistically significantly different from non-participants and average sales for awardees were not statistically significantly different from non-participants. On average, awardee companies nearly doubled in size during the SBV Lab contracts, from 9.6 to 16.1, while non-participant

[10] The three evaluation reports are the current report as well as the Baseline Report and the Early Stage Outcomes Report:
Research Into Action, 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.
Research Into Action, NMR and Gretchen Jordan. 2018. Early Stage Outcomes and Impacts, Round 1, 2, & 3 Awardees DOE/EE-1576. Early Stage Outcomes Evaluation.

companies increased in size during this same period, from 6 to 9.4. The differences between awardees and non-participants is not statistically significantly different.

The following section provides a summary of the key outcomes and indicators of the evaluation, organized by goal. The key outcomes are presented in a condensed form in Table 1.

Goal 1: Lab engagement of small businesses

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 RFAs (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. Two thirds of applicants were firms with less than six employees and over half (55%) of applicants had not previously worked with the labs.

SBV awardees reported high levels of satisfaction with the application portal and process, contracting, and the quality of work with the labs. In addition, 77% of awardees reported they developed new relationships due to SBV, 94% of awardees are likely to work with the labs again, and 96% recommend working with the labs to their colleagues.

Goal 2: Lab awareness of small business needs

The labs learned about the technology-related needs of over 1,200 small businesses through RFAs submitted by those businesses. 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.

Goal 3: Lab commercialization assistance

The 14 labs participating in the pilot contracted with 114 small businesses to provide them with a total of approximately $22 million in assistance, supported by DOE's SBV funding across the nine EERE program offices. The assistance provided by the labs was largely in the form of technical assistance.

While the vast majority of awardees (86%) reported that their technology had advanced at least one stage of development (TRL advancement), awardees demonstrated similar progress over time as non-participants in the development of their technologies: 72% of non-participants reported their technology had advanced at least one stage of development (not a statistically significant difference). However, SBV awardees experienced a statistically significant increase in the percentage of firms whose technology was used by a market from before the SBV award to after (increasing from 34% to 58% of awardees), while the increase experienced by non-participants was not statistically significant (increasing from 17% to 22%). SBV awardees were statistically significantly more likely than non-participants to report use of their technology by the anticipated target market (36% compared to 17%).

In addition, the analysis suggests SBV played a role in market pivots for awardees who needed to pivot their technology to new markets, some of which awardees had never considered. Ten of 12 awardees (83%) who pivoted indicated that their SBV experience had at least a little influence on their pivot to a new market, with two-thirds indicating somewhat or a lot of influence (a statistically significant difference from non-participants). However, we note that there is not a

statistically significant difference in the percent of awardees and non-participants who pivoted to a new market.

Sixty percent of awardees received follow-on funding compared to 56% of non-participants (not a statistically significant difference). As a group, participants received more follow-on funding than non-participants, but the average amount of follow-on funding was not statistically significantly different (with an average of $1.1 million to $1.2 million per awardee and an average of $1.9 to $2.0 million per non-participant). In addition, the share of follow-on funding from private sources appears to have increased for awardees since they received their SBV award compared to before the SBV award, while the share for non-participants declined.

We also note that while responding non-participants reported higher levels of development of intellectual property (IP) (patents, copyrights, or trademarks and scientific publications), the differences are not statistically significant. Seventy-one percent of awardees reported that SBV contributed somewhat or a lot to their development of IP.

Goal 4: 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.

Thirty percent of awardees achieved sales of their SBV-related technology, compared to 17% of non-participants (the differences are not statistically significant). As a group, participants reported more sales than non-participants but the average sales for all participants and all non-participants were not statistically significantly different (with an average value of $200,000 to $224,000 per awardee respondent and average value of $284,000 to $297,000 per non-participant respondent).

We note that the survey-based metrics of *commercialization* are varied. In contrast to reporting sales, when asked whether their technology had been commercialized, 26% of responding awardees and 39% of responding non-participants reported they had (not a statistically significant difference). While, as noted earlier, 58% of responding awardees and 22% of responding non-participants reported their technology was in use by a market. When asked how their technologies were used in the market while not reporting sales, the most common explanation among awardees is that the technology is either at the marketing or prototype stage or that a component of the technology is in use in other markets (see Section 5.2.2).

On average, awardee companies nearly doubled in size during the SBV Lab contracts, from 9.6 to 16.1. Non-participant companies also increased in size during this same period, from 6 to 9.4; the differences between awardees and non-participants is not statistically significantly different. Awardees estimated that their employment would have been lower had their firm not undertaken the SBV project (14.7 on average), while non-participants estimated their firm would have had a similar number of employees (9.3) as the employ today (9.4) had they not applied to SBV. This finding suggests that awardees believed the SBV contracts positively impacted the size of their companies.

Table 1: SBV Goals and Evaluation Metrics

Metric	Indicator	Finding
Goal 1: Lab Engagement of Small Businesses		
Lab outreach and SBV Central Application Portal (CAP)	Increased lab outreach to small business	Labs activated their own network and expanded networks for outreach. Small businesses in 46 states and the District of Columbia submitted RFAs.[1]
	# of SBV applicants	1,200 SBV applicants[1]
	# of SBV registered users to SBV's CAP website	2,400 registered users[1]
	# of small firms (under ten employees) that applied	2/3 of applicants[1]
	% applicants that had not worked with labs previously	55% of applicants[1]
SBV opportunity notice and application process	Application process and funding opportunity notice	94% of awardees reported their expectations of the overall funding opportunity notice were met or exceeded; 81% of awardees reported the application process was easier than applying for other federal awards[3]
	Satisfaction with the Central Assistance Portal (CAP)	78% of awardees said the SBV CAP was easy or very easy to navigate[3]
SBV contracting process	Satisfaction with contracting: expectations were met or exceeded	91% of awardees' expectations were met or exceeded with the amount of time it took to develop the statement of work (SOW); 88% or more of awardees reported their expectations were met or exceeded for all other aspects of contracting[3]
SBV technical assistance	Satisfaction with quality of work provided by labs: expectations were met or exceeded	95% of awardees were satisfied with the overall voucher project experience; over 90% were satisfied with quality of the work, facilities, and staff expertise[3]
Relationships	New relationships formed	77% of awardees reported they developed new relationships[3]
Proportion interested in repeated work with Lab	Proportion very and somewhat likely to work with a Lab again	94% of awardees likely to work with a Lab again[#]
Proportion recommending to colleagues	Proportion recommending to colleagues	96% of awardees recommended to colleagues[#]
Goal 2: Lab Awareness of Small Businesses Needs[#]		
Lab awareness of small business technical needs	Lab pilot manager awareness of small business needs	Interviewed lab pilot managers commonly attributed the pilot to increasing their knowledge of small business; Pilot managers reported awarding vouchers to

Metric	Indicator	Finding	
		unanticipated innovations not encompassed by their technology road maps.[1]	
	Lab awareness of small business needs	Over 1,200 RFAs submitted by small businesses; extensive pilot outreach activities; point-of-contact service, through which they engaged with registered website users[1]	
Goal 3: Commercialization Assistance[#]		**Awardees**	**Non-participants**
Technology readiness (TRL) advancement	Advanced at least one stage of development	86%	72%
Market pivot	Pivoted to a new market (somewhat or full pivot)	24%	33%
	SBV influenced the pivot	10 of 12*	1 of 6
Follow-on funding obtained	Received or invested follow-on funding	60%	56%
	SBV influenced source or amount of follow-on funding	54%*	11%
	Total follow-on funding	$53 to $55 million	$33 to $34 million
	Average follow-on funding	$1,127,000 – 1,178,000	$1,947,000 – 2,000,000
	Percent of follow-on funding from private sources, pre-SBV	50%	48%
	Percent of follow-on funding from private sources, post-SBV	59%	35%
Intellectual property and business developments	Percent who received a patent, copyright, or trademark	23%	44%
	Percent with scientific or technical publication	33%	44%
	SBV contributed to development of intellectual property (somewhat or a lot)	71%*	7%
	Public offering (made or planned), spin off, acquired by another firm	10%	22%

Goal 4: Commercialization Success	**Awardees**	**Non-participants**

Metric	Indicator	Finding	
Market for the technology	Percent of firms with a technology used by any market segment, pre-SBV	34%	17%
	Percent of firms with a technology used by any market segment, pre-SBV	58%*	22%
	Use by anticipated target market, post-SBV	36%*	17%
Technologies commercially launched	Commercialized the SBV technology	26%	39%
	SBV contributed to commercialization	94%*	33%
	Achieved sales of SBV-related technology	30%	17%
	Total sales, post-SBV	$9.6 million to $10.8 million	$5.1 million to $5.4 million
	Average sales, post-SBV	$200,000 – 224,000	$284,000 – 297,000
Employment effects from technology	Average number of employees, time of SBV award	9.6	6.0
	Average number of employees, post-SBV award	16.1	9.4

*Statistically significantly different from non-participants at the 90% confidence level.
When multiple evaluations obtained a given metric statistic, this table provides the statistic from the most recent evaluation.
[1] 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.
[2] RIA, NMR and Gretchen Jordan. 2018. Small Business Vouchers. Evaluation. Round 2 Awardees Preliminary Results. DOE/EE-1576. Round 2 Awardees Preliminary Results
[3] RIA, NMR and Gretchen Jordan. 2018. Early Stage Outcomes and Impacts, Round 1, 2, & 3 Awardees DOE/EE-1576. Early Stage Outcomes Evaluation

RECOMMENDATIONS

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

1. Consider encouraging the labs to continue outreach to and develop partnerships with small businesses. There is high interest from small businesses, awardees and non-participants alike, to work with the labs. Awardees clearly indicated that their work with the labs helped them to commercialize their technology, receive follow-on funding, develop intellectual property, and determine when and how to pivot to new markets.
2. Consider offering a program to provide small businesses access to the labs. Continue to provide a simple and clear process whereby a small business can approach the labs with a request, have its request assessed on its merit, be matched with an

appropriate lab and PI, and have a relatively simple contract developed and executed relatively quickly

3. Consider whether the SBV-developed form Cooperative Research and Development Agreement (CRADA) could serve as a template for streamlining standard CRADAs. 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 by developing short, standardized contracts for awardees: a short-form CRADA. Awardees' expectations about the SBV contracting process were almost all met or exceeded.
4. Consider whether the SBV-developed application processes could be continued. For the SBV pilot, small businesses completed a short (about five-page) request for assistance, submitted the request through an application portal. The majority of SBV Awardees found that the application process and funding opportunity notice met or exceeded their expectations.
5. If comparison groups are to be included in the evaluation design, early discussions among evaluators and program staff should confirm the availability of the necessary data for fair and credible comparisons. This could require helping program staff understand the evaluation challenges, confirm that the program is willing and able to collect the additional data needed, and find ways to ensure that both participant and comparison group cooperation with data collection will be at least moderately high over the course of the evaluation.

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 outcomes and impacts awardees evidenced through August of 2019, ranging from 28 to 42 months since the announcements of the awards, 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.

Earlier SBV studies conducted by the evaluation team addressed the first three of these goals.[11] 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 RFAs (applications for vouchers). About twice the number of applying small

[11] Research Into Action, 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.

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 areas for which SBV offers vouchers. Pilot processes made it easy for small businesses to participate.[12]

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 RFAs. 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 technical assistance, supported by DOE's SBV funding across the nine EERE program offices (see Table 2, below), to resolve technical issues that are hindering their technologies. About two-thirds of the vouchers were for cooperative research and development, and one-third were for technical assistance (TA). 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 to those without such experience or who did not seek information found no differences in the application-calculated TRLs.[13] 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.

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

[13] 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. We 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.

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

The SBV pilot offers U.S.-based and -owned small businesses in the clean energy sector the opportunity to receive world-class, tailored TA 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 (PIs) with whom the program team pairs them.[14] The paired lab is chosen from among 14 national labs as the lab best positioned to conduct the research.[15] 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.[16]

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 2 provides the SBV funding amounts and the number of projects awarded by technology area.

[14] 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.
[15] 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.
[16] Cost-share requirements are statutory. Energy Policy Act (EPAct) of 2005, Section 988.

Table 2: 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 the following activities:

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

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, 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.[17]

Each round is initiated with pilot outreach (inviting small businesses to apply).[18] The small businesses apply by submitting a short (about five pages)[19] RFA that includes descriptions of (1) the company, (2) the technical challenge faced and how the requested assistance would help to overcome the challenge, (3) the potential project impact (such as cost savings or increased performance; issues related to DOE EERE mission areas), (4) how the company will use the project results, (5) key company team members, and (6) how the firm will provide the required 20% cost share. As part of the application process, the company needs to register on the 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.

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 the following:
    - alignment with the technology area's mission;
    - innovativeness; and

[17] 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.

[18] 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 Research Into Action, NMR and Gretchen Jordan. 2016. Baseline and Process Evaluation of Small Business Vouchers Pilot. DOE/EE-1574. SBV Baseline and Process Evaluation.

[19] 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.

  - market impact, including how the assistance will advance the small business's technology and how the technology will advance the market.

- Problem definition – comprising the following:
  - problem identification; and
  - quality and reasonableness.

- Team and resources – comprising the following:
  - capabilities; and
  - resources.

A minimum of two independent expert reviewers scored each submittal for each round. [20]

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 Cooperative Research and Development Agreements (CRADAs), TA Agreements, Strategic Partnership Projects (SPP),[21] and Agreements for Commercializing Technology (ACT), among others. [22] 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.

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 TA 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

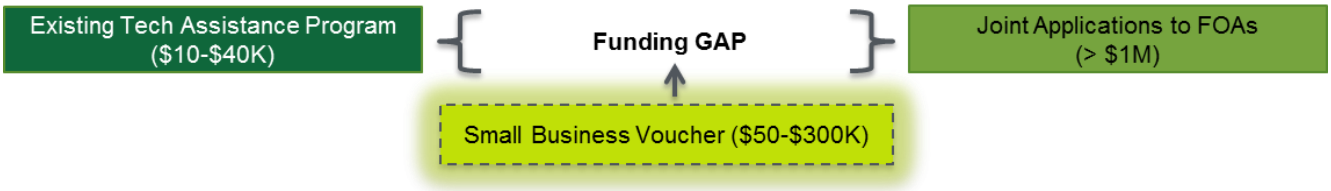
[20] From the Baseline and Process Evaluation of Small Business Vouchers Pilot (DOE/EE-1574), page 5:" One knowledgeable lab pilot manager estimated that about half the RFAs received had some merit – that is, described a technical challenge for which a solution might yield technology innovation, which 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."

[21] Strategic Partnership Projects were previously called Work for Others (WFO) Agreements

[22] 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.*

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.[23]

Figure 1: Funding Gaps



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."[24] According to inventor Richard C. Levy, "90% of an invention's success is marketing it and getting it out."[25] 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-goods and retail products fail to earn even $7.5 million during their first year.[26] 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 participants as they think through nine areas considered necessary to commercialize a new technology.[27] The training builds on the respected Lean LaunchPad® entrepreneurship curriculum, which business professor Steve Blank developed

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[23] *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.

[24] 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

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

[26] 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."

[27] 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.

in response to critiques that traditional commercialization instruction was far too narrow to do justice to the complexity of the commercialization challenge.[28]

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."[29] Companies use the 13 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. [30,31] 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 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:[32]

- **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.[33]
- **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

[28] 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
[29] https://www.stage-gate.com/aboutus_ourstory.php
[30] 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
[31] 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
[32] The Bozeman model includes a fifth element pertinent only to technology transfer out of the lab, which does not describe the SBV program.
[33] 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.

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.

Section 2 SBV Logic and Study Approach

2.1 The Logic of SBV in Advancing Commercialization

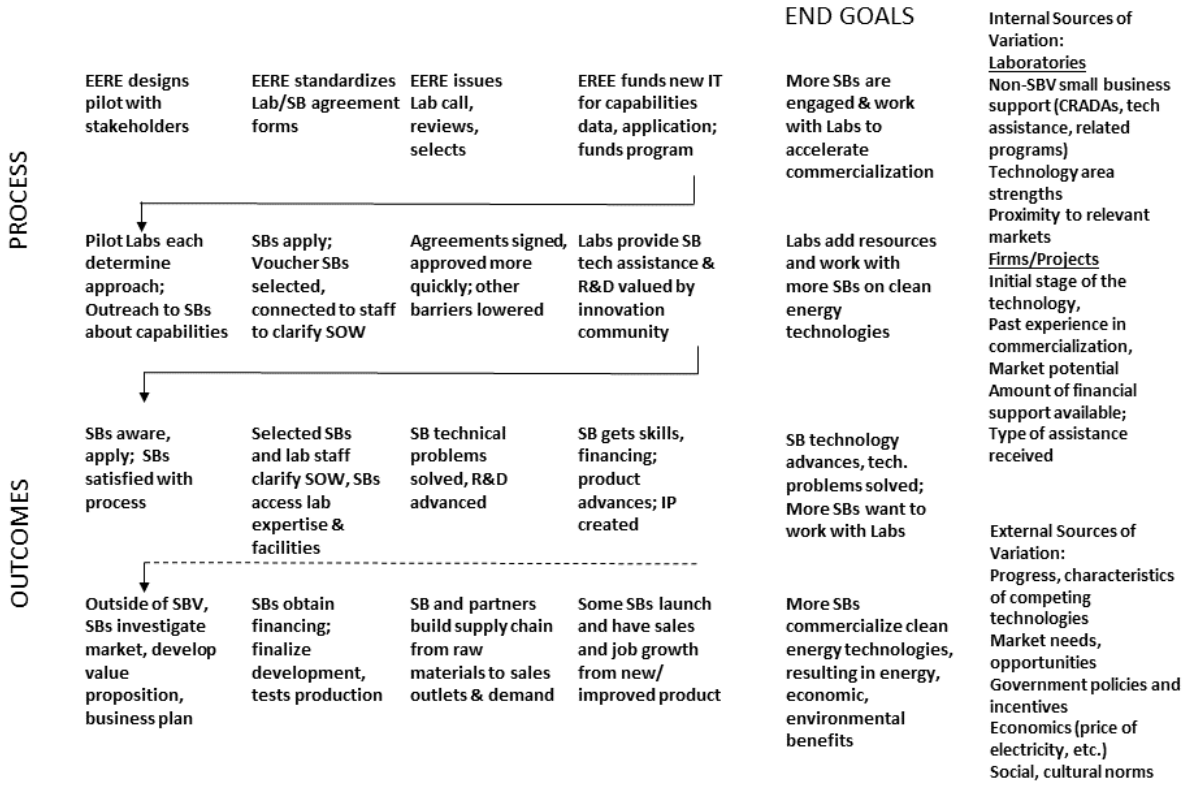
SBV provides free (via vouchers) TA to selected small business to advance the technological development of their innovations. It provides these small businesses with professional research from expert national laboratory scientists and engineers, and provides them with access to unique, state-of-the-art lab equipment and facilities.[34]

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)."[35]

Figure 2 illustrates the pilot's logic.

[34] 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.
[35] 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 important caveats and limitations affecting the study's testable hypotheses.

2.2.1 Commercialization Assistance: Technology Advancement

***Intended SBV 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 does not exceed that of comparably meritorious technologies being developed by non-awarded businesses (that is, non-participants) in a given period.[36] 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 to the market more satisfactorily than comparison technologies. The marketplace 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. The team found no association between the amount of the SBV award and TRL advancement (see Appendix C.5). The team also notes the study's small sample sizes of 50 awardees and 18 non-participants and the relatively narrow range of the awards ($38,000 to $317,000).

2.2.2 Commercialization Assistance: Follow-on Funding

***Intended SBV 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 are not more likely to receive follow-on funding than non-SBV technologies nor are they more likely to 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. 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.

[36] 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 2.5.

2.2.3 Commercialization Success: Offered for Sale and Used in the Market

***Intended SBV Outcome*: Technologies that have advanced to the point of market readiness (irrespective of whether follow-on funding was received) are now offered for sale**.[37] This is the claim that SBV drives commercialization.

Testable hypothesis: SBV-advanced technologies do not make it to market in greater proportions than technologies from 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. We found that awardees with more advanced starting TRLs were more likely to have achieved sales after receiving the SBV award and have their technology in use in any market (see Appendix C.5).

2.2.4 Commercialization Success: Sales Success

***Intended SBV 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. In addition, sales implies that there may be comparative advantages for the product/technology over current technologies.

Testable hypothesis: SBV-advanced technologies do not have greater revenue or employment impacts than comparison technologies.

Testable hypothesis: SBV-advanced technologies do not have a longer market presence than comparison technologies. They are just as 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.

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). [38] At times, EERE has included TRL

[37] 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.
[38] Appendix A defines the TRL levels.

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.[39]

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.[40] 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.[41]

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

2.4 LIMITATIONS TO COMPARISON GROUP METHODOLOGY

The initial five year evaluation plan cautioned that there would be challenges in establishing a credible comparison group, especially given the expected variation in voucher firms and technologies addressed in projects and the complexity of any innovation and adoption context. This variation makes it very difficult to find comparison groups that are similar and remain similar over a period of time.

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[39] Each TRL 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.

[40] https://www.gao.gov/assets/680/679006.pdf

[41] 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.

We identified factors that might confound the interpretation of the pilot results by suggesting either the pilot was more effective or less effective than it actually was (Type 1 and 2 errors). Confounding factors include the identified internal influences on the pilot, such as initial stage of the technology, anticipated level of technical and market difficulty, technology sector, past commercialization experience, non-SBV resources and support, form of agreement with the Labs, Lab processes for working with small businesses, and Lab location. External to the program are influences that include DOE business infrastructure; market needs/ opportunities; R&D and deployment progress outside EERE and the Labs; competing and supporting technologies; other government policies and incentives; economic factors, including energy prices; price of what the new product would replace; availability of skilled labor; and social and cultural norms, such as consumer preferences and time horizon.

For the evaluation, evaluators initially thought that at the end of eighteen months they would use the other small business CRADA projects completed within the previous year at the Labs participating in the SBV pilot. Anticipating that follow up on these projects was not feasible for the evaluation of impacts in Year Five, we planned to benchmark the progress of SBV participants against SBIR Phase I awards. Neither approach turned out to be feasible, so the fall back for both evaluations was the pool of applicants who were just below the cut off for funded vouchers.

Further, most data on the confounding factors could not be collected for various reasons. Thus, the evaluators were limited in our attempts to "hold them constant" in our assessments by explicitly comparing outcomes within and across confounding conditions. With more data on confounding factors (variables), the evaluators could have more reliably identified the pilot's contribution to working with small businesses on product advancements and commercialization.

2.5 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
- Use in the market: later 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.

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

Figure 3: SBV Award and Survey Timeline

	2015				2016												2017											
Awardee Round	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

Awardee Round (continuing from 2017 Quarter 4)	2018												2019											
	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	S																				S	S		
Round 2																					S	S		
Round 2 non-participants																					S	S		
Round 3	S																				S	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 (with a maximum score of five). 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.[42] The team was unable to include Round 1 and 3 non-participants in the comparison group due to lack of merit-review data. [43]

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, 50 awardees and 18 non-participants responded to the surveys (response rates of 65% and 51%, respectively).[44] Response rates are based on the sample of respondents to the previous surveys completed in 2017 (all non-respondents to the previous surveys were excluded). The 50 awardees who responded include 17 Round 1 awardees, 17 Round 2 awardees, and 16 Round 3 awardees. Table 3 shows response rates by EERE Technology Office.

[42] There were 346 non-participants in Round 2 and 1,226 total non-participants across all three rounds.
[43] 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.
[44] The lower response rate for non-participants may result in non-response errors, as discussed in Section 2.4.

Table 3: SBV Survey Response Rates

EERE Technology Office	Awardees			
	Total	Sample	Number of Responses*	Response Rate
Advanced Manufacturing	23	**17**	14	82%
Bioenergy	12	**9**	8	89%
Buildings	11	**7**	4	57%
Fuel Cells	20	**14**	11	79%
Geothermal	7	**4**	1	25%
Solar Power	9	**7**	5	71%
Vehicles	17	**12**	5	42%
Water Power	10	**4**	1	25%
Wind Power	6	**3**	1	33%
Total	**115*** **	**77**	**50**	**65%**
	Non-Participants			
	Total	Sample	Number of Responses**	Response Rate
Advanced Manufacturing	26	**8**	5	**63%**
Bioenergy	10	**4**	2	**50%**
Buildings	19	**4**	3	**75%**
Fuel Cells	2	**0**	0	**--**
Geothermal	4	**2**	0	**0%**
Solar Power	20	**7**	2	**29%**
Vehicles	18	**4**	2	**50%**
Water Power	13	**3**	2	**67%**
Wind Power	9	**3**	2	**67%**
Total	**121**	**35**	**18**	**51%**

*Excludes one awardee who began but did not complete the survey and two who did not advance past the screener questions.
**Excludes two non-participants who began the survey but did not respond to any questions and three non-participants who did not advance past the 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.

2.5.1 Treatment of SBV Rounds

The SBV pilot served an average of 38 small businesses in each of three rounds, with an average of 17 awardees per round responding to the survey; a total of 18 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.[45]

[45] It is also worth noting that statistically significant findings should also be interpreted with some caution due to the small sample sizes.

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 timeline of award announcements and survey efforts (Figure 3, above), this report primarily provides findings from the most recent wave of data collection pertaining to the pilot's early stage outcomes and impacts of labs' efforts to address the third goal, commercialization assistance (goal 3), the extent to which SBV technologies reach the commercial market as the initial part of the fourth goal (goal 4), and information to help assess engagement (goal 1).

2.5.2 Early Outcome Metrics and Data Sources

Table 4 provides the SBV goals and evaluation metrics addressed by the data collected for this study.

Table 4: SBV Goals, Evaluation Metrics, and Survey Data Sources

Metric	Awardees	Non-participants
Goal 3: Commercialization Assistance		
Proportion for which technology readiness (TRL) advanced	✓	✓
Amount with follow-on funding obtained	✓	✓
Amount of follow-on funding obtained	✓	✓
Market pivot and SBV influence	✓	✓
Intellectual property	✓	✓
Goal 4: Commercialization Success		
Proportion with technologies in use by a market segment	✓	✓
Proportion with technologies commercially launched (a sale)	✓	✓
Sales revenues	✓	✓
Employment effects from technology	✓	✓
Goal 1: Engagement of Small Businesses		
Proportion interested in repeated work with lab	✓	✓
Proportion recommending to colleagues	✓	✓

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

- Proportion for which intellectual property (IP) was created or licenses obtained
- Proportion engaged in public offerings, spin-offs, acquisition, or mergers

2.5.3 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 2.1.

All study data were reported by the small businesses, either to DOE through the SBV application process or to us through our web surveys. A limited number of data points (patents) 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. While awardees and non-participants had relatively high response rates (65% and 51%, respectively), awardees had a higher response rate, 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. More limiting than response rates are the low sample sizes; despite the high response rates, samples of 50 and 18 limit the statistical analyses we can perform and reduce the likelihood of detecting differences in outcomes that may exist but for which we lack the statistical power to detect.

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. 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)
- Age of firm
- TRL (score determined by the pilot using responses to the RFA questionnaire)
- Type of technology
- Continued involvement with the SBV technology
- Previous experience with commercialization (94% non-participant respondents reported previous experience in the 2017 survey compared to 86% of awardees)

Awardees differed statistically significantly from non-participants for only one characteristic:

- Demonstrated feasibility of technology in the lab. Round 2 and 3 awardees were more likely than non-participants to have demonstrated the feasibility of their technology in the lab before applying to SBV, according to their RFAs (100% compared to 83%)

3.2 Non-participants as Comparison to Awardees

This section assesses non-participants as a comparison to awardees, investigating the following characteristics we were able to collect sufficient data for comparison:

- Technology readiness as reported in applicant's RFA
- 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
- Continued involvement with the SBV technology

3.2.1 Technology Readiness per RFA 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 TRLs for the proposed technologies, as scored by the pilot team from applicants' responses to a series of questions (Table 5).[46] As reported in Appendix C, there are no statistically significant differences among the three rounds of participants and non-participants.

Table 5: Technology Readiness Level (TRL) per RFA Submittal

TRL Metrics	All SBV Awardees (n = 40*)	Non-participants (n = 18)
Minimum TRL	0.0	0.0
Maximum TRL	9.0	9.0
Mean TRL	6.1	5.6
Median TRL**	7.1	7.1

* TRL was only available for six 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 6). About one-third (30%) of awardees and one-quarter of non-participants (22% or four non-participants) reported achieving sales of some kind related to their SBV-technology before applying to SBV.[47]

Table 6: Technology Status Questions from SBV Application

SBV Application Question	Percent *Yes*	
	Awardees (n = 40*)	Non-participants (n = 18)
Have you demonstrated the feasibility of the technology in the lab?	98%	83%
Have you created and tested (or are in the process of testing) a prototype?	83%	72%
Have you demonstrated/Are you currently demonstrating the product/service in an initial pilot project or demonstration?	53%	61%
Have you achieved sales – more than one – and are actively seeking more sales?	30%	22%

* Technology status application data was only available for six of the 16 Round 3 awardees.

[46] The pilot developed a TRL score for each technology through applicants' responses to a series of questions about their technologies.
[47] Note that these questions are similar to the TRL technology development stages reported in Figure 4, but while Table 6 is reporting individual achievements pertaining to their technology, Figure 4 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 (such as technical process development, data modeling, and system design) and hardware (such as materials testing and manufacturing) must suffice.[48] Awardees and non-participants are not statistically different with respect to technology type (Table 7). We note that software technologies typically have a shorter developmental cycle (time to market) than hardware technologies.

Table 7: Technology Type

Technology Type	Awardees (n = 50)	Non-participants (n = 18)
Software	36%	39%
Hardware	64%	61%

3.2.3 Ages and Sizes of Firms

SBV awardee firms are about eight years old on average, compared to an average age of 11 years for non-participant firms (Table 8, 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 ten to 22 people on a full-time equivalent basis. One non-participant was an outlier, reporting 300 employees. [49] Note that Table 8 is reporting data from the RFA, which only includes data on six of the Round 3 awardees, whereas the findings on size of firms reported in Section 4 use data from the evaluation survey.

Table 8: Size and Age of SBV Awardee and Non-participant Firms as Reported in the RFAs

Age and Size Metrics	All SBV Awardees (n = 39*)	Non-participants (n = 18)
Age of Firm		
Minimum Age (years)	0	0
Maximum Age (years)	24	40
Mean Age	7.5	10.4
Median Age	5	7
Full Time Employees (FTEs)		
Minimum FTE	0	0
Maximum FTE	42	300
Mean FTE	9.5	22.3
Median FTE	4	4

* The n for SBV awardees for FTEs was 40; age was available for five of the 25 Round 3 awardees, but FTE employees was available for six.

[48] 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*.

[49] The outliers by firm age and size are not the same firm.

3.2.4 Current Involvement with SBV Technology

Finally, there are no statistically significantly differences in the likelihood that awardees (84%) or non-participants (89%) reported continuing their involvement with their SBV technology.

Section 4 Findings: Goal 3 - Commercialization Assistance

4.1 Advancement of Technology Readiness Levels

Advancement in TRL is the key outcome of the SBV pilot, as discussed in Section 2.1. We asked awardees and non-participants to assess, on a nine-stage scale, the development of their technology at the time of the survey[50] and to assess the stage retrospectively at the time they applied to or received the SBV award.[51] 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 (3.1 compared to 3.6) but demonstrated similar progress over time in the development of their technologies and advancing the TRL levels of their technologies (see Table 9, Figure 4, and Figure 5). While 76% 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). Further, 86% of awardees reported their technology had advanced at least one stage of development (Figure 5). 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).

[50] We surveyed Round 1 awardees 42 months after the SBV award announcement, Round 2 awardees and non-participants 36 months after the award announcement, and Round 3 awardees 28 months after award announcement.

[51] 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.

Table 9: Stage of Development at Time of SBV Award and at Time of Survey

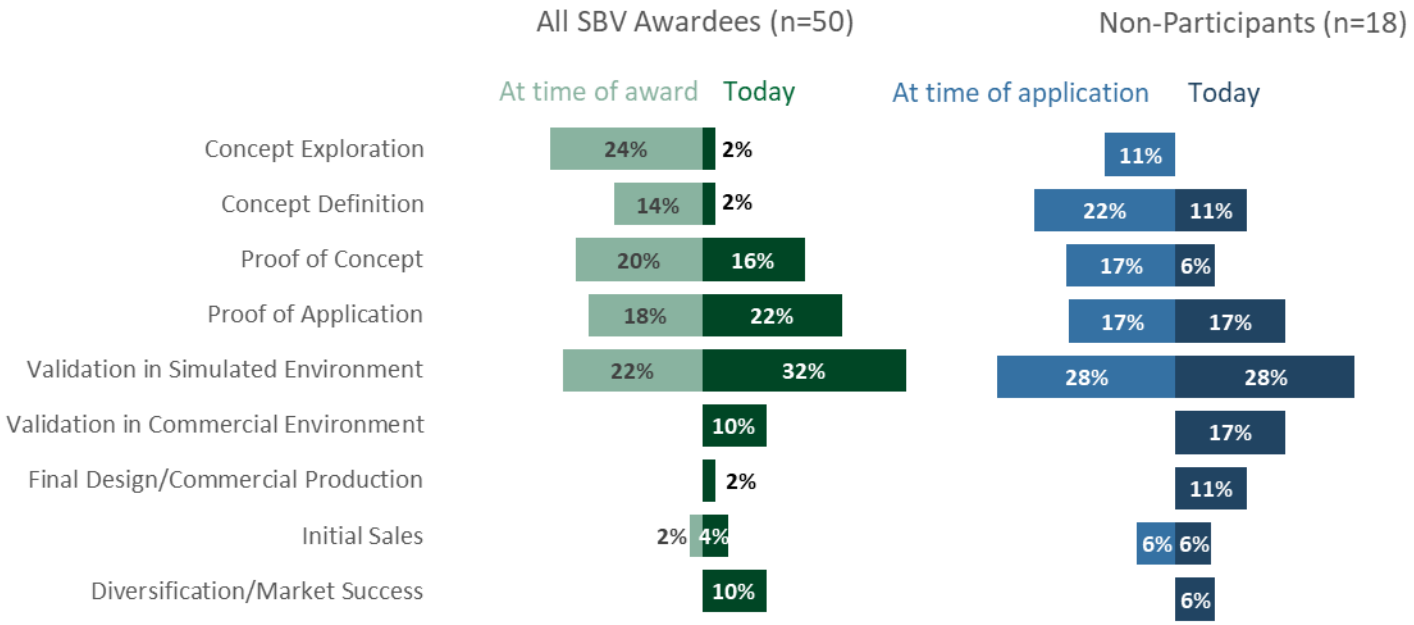
Stage of Development/ Commercialization	Awardees		Non-participants	
	Time of SBV Award* (n = 50)	Time of Survey (n = 50)	Time of SBV Application* (n = 18)	Time of Survey (n = 18)
Conceptualization and proof of concept (1 to 4)	76%**	42%	67%**	33%
Validation stages (5 & 6)	22%**	42%	28%	45%
Commercialization stages (7 to 9)	2%**	16%	5%**	22%
Average	3.1	5.0	3.6	5.2

*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 from time of the survey at the 90% confidence level.

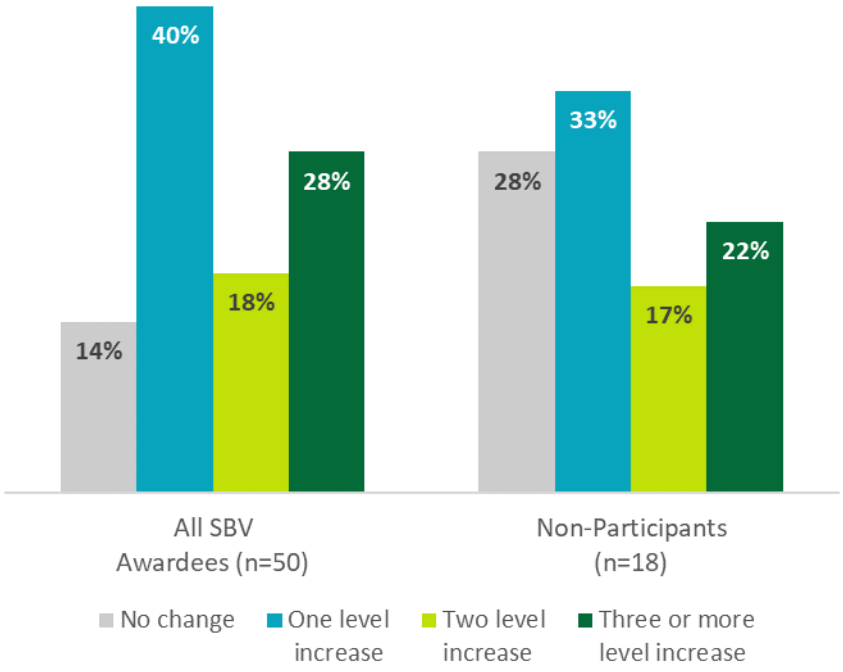
Figure 4 provides a more detailed examination of change in stage of development by illustrating responses at each of the nine developmental stages.

Figure 4: Stage of Development Before and After SBV Award



SBV awardees advanced to a higher stage of development at a similar rate as non-participants; 86% of awardee respondents and 72% of non-participants reported their technology had advanced at least one stage of development (not a statistically significant difference). Just over one-quarter (28%) of non-participants reported that they were at the same levels of development at the start and end of the study period, compared to over one-tenth (14%) of SBV awardees (not a statistically significant difference) (Figure 5). As a group, the stage of development among awardee respondents increased by an average of approximately 1.9 levels from SBV award to time of survey,[52] compared to an average of 1.6 levels among non-participants. The difference was not statistically significant.

Figure 5: Change in Stage of Development

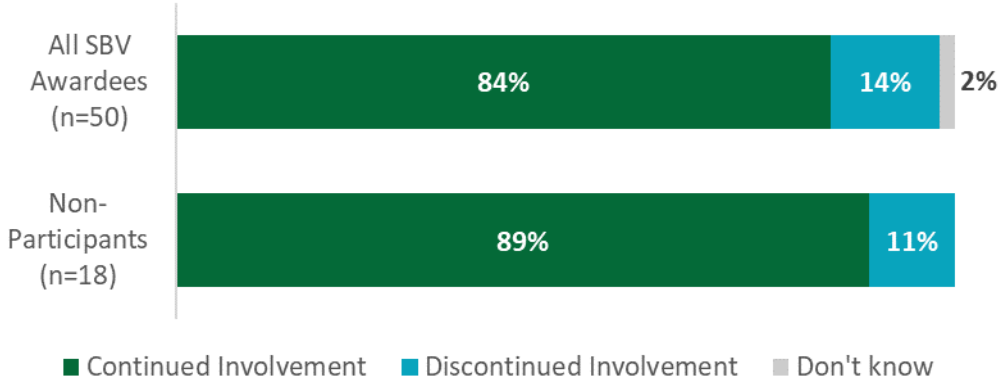


[52] There is no *typical* progression of TRL over time. Among entrepreneurs, TRL progression is highly dependent on such factors as (1) the complexity of the innovation (software may reach commercialization within a year or two, while some innovations can take more than a decade), (2) the characteristics 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 changes of direction [*pivots*] are needed? How substantial are the changes needed?). See Section 2.1.

4.1.1 Current Status of SBV Technology

Nearly identical percentages of awardees and non-participants continue their involvement with their SBV technology (84% and 89%, respectively). These were not statistically significantly different.

Figure 6: Continued Involvement with SBV Technology



For those who have discontinued working with their SBV-technology, technical and funding obstacles were the most commonly cited reasons (Table 10).

Table 10: Reasons for Discontinuing Efforts Related to SBV Technology (multiple responses permitted)

Reasons for Discontinuing Efforts	SBV Awardees (n = 7)	Non-Participants (n=2)
Technical failure or difficulties	4	0
Not enough funding	4	1
Level of technical risk too high	3	0
Company shifted priorities	2	0
Project goal was achieved	1	0
Inadequate sales capacity	1	0
Company restructured	1	0
Not commercially viable	1	0
Was not awarded a voucher through SBV	0	1
Not operationally feasible	1	0

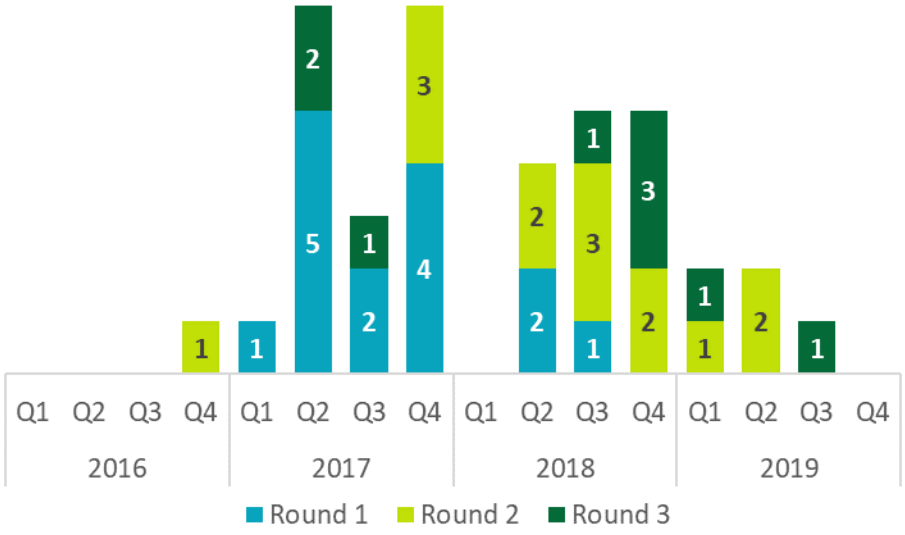
When asked to identify the primary reason for discontinuing efforts related to the SBV technology, four SBV awardees indicated technical failure or difficulties, two indicated not enough funding, one indicated inadequate sales capacity, and one determined that the project was not operationally feasible..

In addition, several awardees provided details about the impacts of SBV on their decision to discontinue working with their technology. A common theme was that SBV allowed the awardees to further explore their technology, but they eventually determined that they had to move in a different direction or that the technology was not commercially viable:

- *In absence of SBV we wouldn't have been able to try to solve that very problem - that is scientific questions that needed to be answered to transition the technology to a viable solution.*
- *Yes, discussions with the lab helped us realize another direction would have more value for us.*
- *SBV project helped continue the project for longer than we could have normally.*
- *Project goals were achieved but it was determined that it operationally was not feasible.... Proven to work, but took too much time and equipment… Feasible, yes. Commercially viable- no.*

Among the 38 firms that specified when they completed their SBV research project with the lab, Figure 7 shows completion date by round of award.

Figure 7: Completion Date of SBV Research Project with the Lab



4.1.2 Market Pivot

The majority of respondents reported that they are still targeting their original market with their SBV-related technology. Approximately one in five awardees (18%) and non-participants (22%) reported having somewhat pivoted to a new target market, while 6% of awardees and 11% of non-participants reported fully pivoting to a new market (Figure 8).

Figure 8: Pivoted to a New Target Market

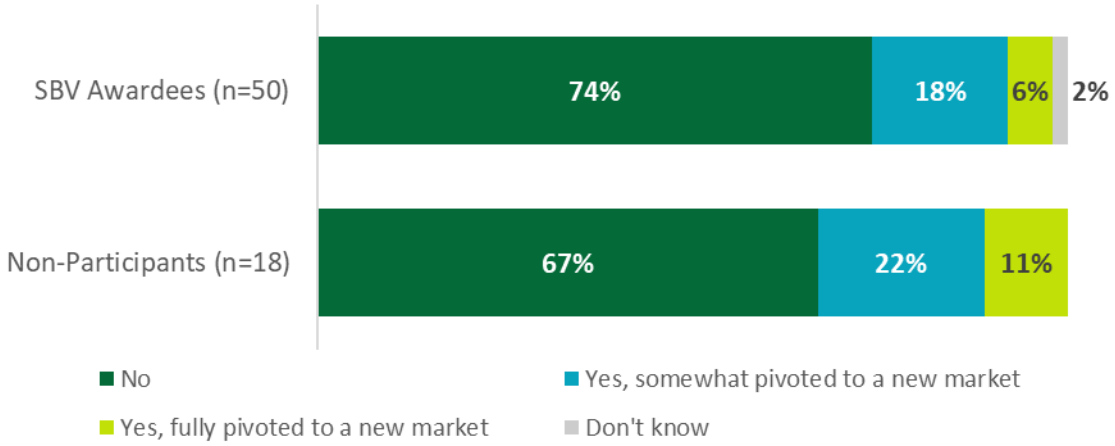


Table 11 shows the new markets targeted by firms who pivoted from the original target market specified in the application.

Table 11: New Target Markets

Target Market	SBV Awardees (n = 12)	Non-participants (n = 6)
Manufacturing	3	0
Fuel cells	1	0
Electricity	1	2
Automobile / EV	1	1
Commercial & Industrial	1	0
Biofuels	0	1
Renewables	1	0
Building envelope/windows	1	0
Water treatment	1	0
Other	2	2

Ten of 12 awardees who pivoted indicated that their SBV experience had at least a little influence on their pivot to a new market, with two-thirds indicating somewhat or a lot of influence. Most non-participants (four of six) reported that the SBV experience did not influence them at all when pivoting to new target markets (Figure 9).

SBV awardees indicated various avenues through which the SBV experience influenced their pivot to new target market(s). One awardee reported that the SBV experience assisted the firm in responding to unexpected changes in pricing in the original target market:

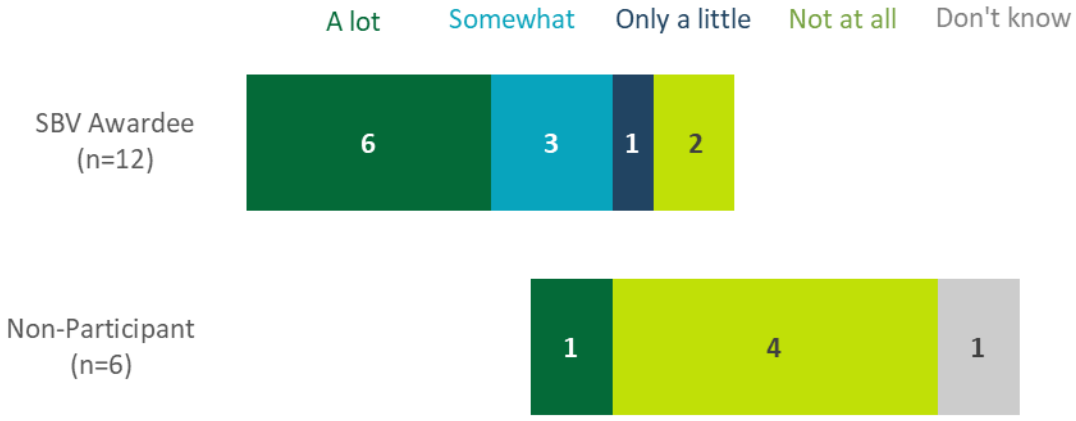
> *"The SBV work allowed us to have a much better understanding of the impacts of various parameters/trade-offs in designing and fabricating these devices… By knowing the capabilities of the device (assisted by the SBV), we are able to extend to other markets which may provide improved profitability at this time."*

Another awardee noted that they had to reassess their TRL as a result of the SBV pilot:

> *Understood technology readiness level was lower than though[t] and needed to move up the value chain*

Other awardees who reported that the SBV experience had a strong impact on their pivot to a new target market indicated that the SBV experience helped their firm prove themselves in the original target market, which opened up new opportunities, provided independent verification of the technology, and helped them to identify new markets they had not originally considered.

Figure 9: Influence of SBV Experience on Pivot to New Target Markets



4.2 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. Follow-on funding is an indicator that investors see future potential in the effort. The amount of funding required increases as the technology moves up the TRL levels. That said, costs differ greatly depending on the technology and market. As noted in Section 3.2.4, high percentages of awardees and non-participants are still involved with their SBV technologies (84% and 89%, respectively).

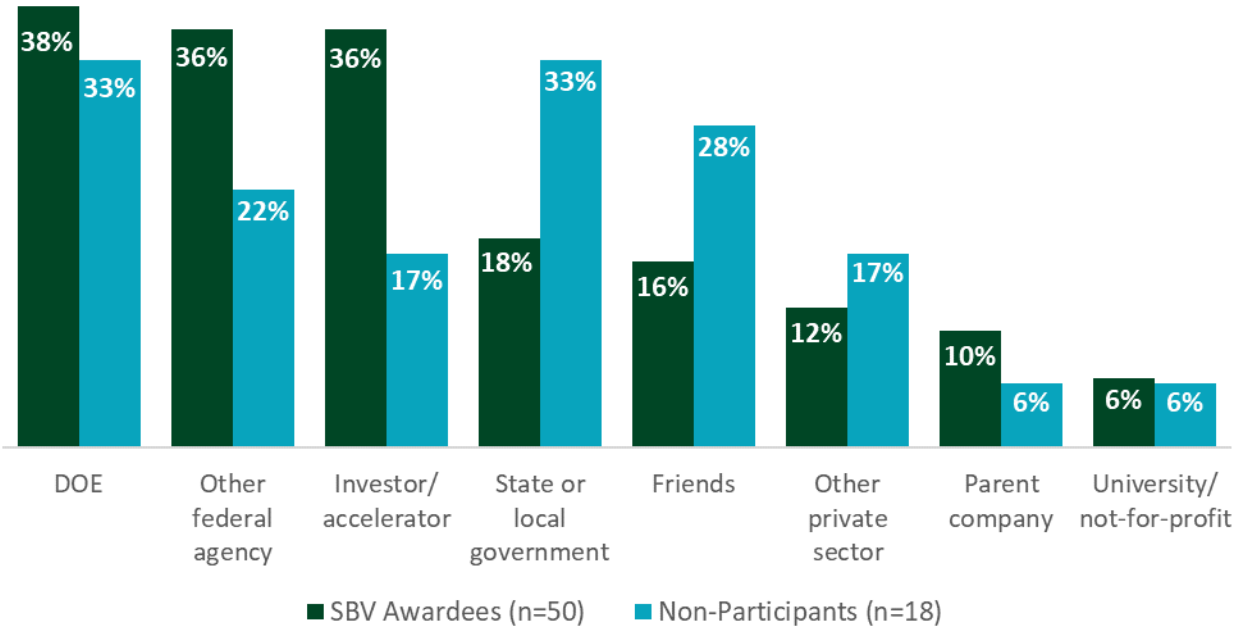
Over one-half of SBV awardees (60%) and non-participants (56%) reported receiving or investing additional developmental funding in their SBV-supported technology since their SBV awards or applications (Figure 10). This finding is statistically similar between awardees and non-participants. The team examined follow-on funding by round and several factors, including technology type, starting TRL, commercialization experience and size of SBV award (Appendix C) and found no differences in rates of follow-on funding between awardees and non-participants

for any rounds. However, Round 2 awardees had statistically significantly lower rates of follow-on funding comparted to other rounds of awardees. There were no differences among awardees by any factors except for previous commercialization experience, which was associated with a **lower** likelihood of follow-on funding.

Figure 10: Received or Invested Additional Development Funding

Figure 11 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 DOE investment, followed by investment from another federal agency and private investment from an investor or accelerator (for awardees).

Figure 11: Received or Invested Additional Development Funding by Funding Source



Twenty-seven awardees and eight 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 $249,999
- $250,000 to $499,999
- $500,000 to $749,999
- $750,000 to $999,999
- $1,000,000 to $1,249,999
- $1,250,000 to $1,449,999
- $1,500,000 to $1,749,999
- $1,750,000 to $1,999,999
- $2,000,000 to $2,249,999
- $2,250,000 to $2,499,999
- $2,500,000 to $2,749,999
- $2,750,000 to $2,999,999
- $3,000,000 to $3,249,999
- $3,250,000 to $3,499,999
- $3,500,000 to $3,749,999
- $3,750,000 to $3,999,999
- $4,000,000 to $4,249,999
- $4,250,000 to $4,499,999
- $4,500,000 to $4,749,999
- $4,750,000 to $4,999,999
- $5,000,000 to $5,499,999
- $5,500,000 to $5,999,999
- $6,000,000 to $6,499,999
- $6,500,000 to $6,999,999
- $7,000,000 to $7,499,999
- $7,500,000 to $7,999,999
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- $9,000,000 to $9,499,999
- $9,500,000 to $9,999,999
- $10,000,000 to $10,999,999
- $11,000,000 to $11,999,999
- $12,000,000 to $12,999,999
- $13,000,000 to $13,999,999
- $14,000,000 to $14,999,999
- $15,000,000 and up

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 $15,000,000 and more, to which we assigned a value of $15,000,000. 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 $15,000,000. For example, the value of $50,000 is used if the respondent selected the first range of under $100,000. Table 12 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 $53 to $55 million, with an average of $1.1 million to $1.2 million per awardee. In comparison, the sum of estimated additional funding across non-participants who reported receiving additional funding ranges from $33 to $34 million, with an average of $1.9 to $2.0 million per non-participant (not a statistically significant difference). For more details on the distribution of funding awards, see Appendix C. The slightly lower average for awardees may be due to a high count of the smallest category of under $250,000.

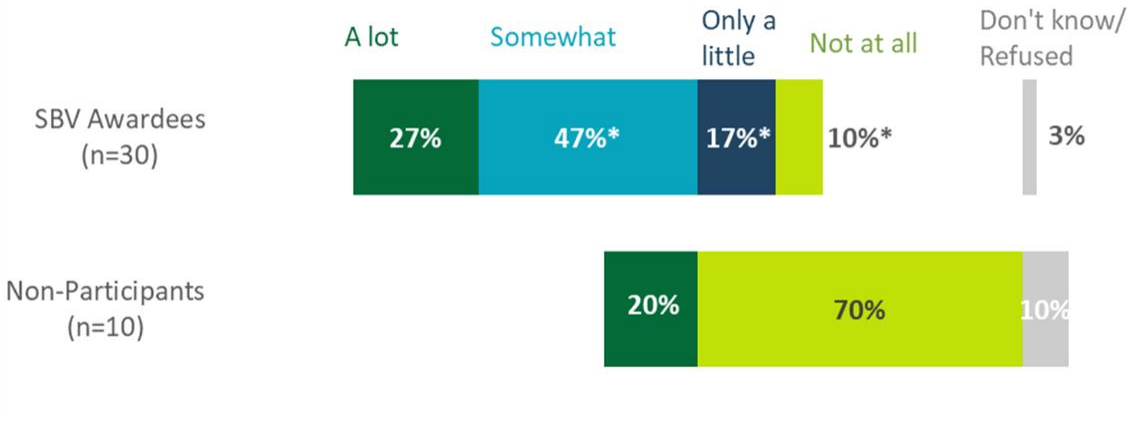
Table 12: Estimated Additional Funding ($ thousands)

Funding Source	SBV Awardees (n = 47)	Non-participants (n = 17)
Total Reported Funding	$52,960 – 55,375	$33,100 – 34,000
Average Funding, all respondents[1]	$1,127 – 1,178	$1,947 – 2,000

[1] For average funding, respondents who reported no additional funding were given a value of $0 and “don’t know” responses were excluded.

When asked what influence the SBV experience had on funding received, SBV awardees were more likely to have responded that the program had "a lot" or "somewhat" of an influence, compared to non-participants, 70% of which said the SBV experience influenced funding "not at all" (Figure 12). Overall, 54% of all awardee respondents and 11% of all non-participant respondents reported that SBV influenced follow-on funding (a statistically significant difference).

Figure 12: Influence of SBV Experience on Funding



* Statistically significantly different from non-participants at the 90% confidence level.

The share of follow-on funding from private sources appears to have increased for awardees since they received their SBV award compared to before the SBV award (Table 18). In contrast, the share of private funding for non-participants appears to have declined (while government funding has increased).

Table 13: Estimated Percent of Additional Funding from Private and Government Sources (weighted by amount of follow-on funds)[53]

Follow-on funding (% of funding)	SBV Awardees (n = 27)		Non-participants (n = 8)	
	Pre-SBV	Post-SBV	Pre-SBV	Post-SBV
Private	50%	59%	48%	35%
Government	48%	40%	52%	65%

[53] Respondents provided percentages of private and government follow-on funding. We used the midpoint of the funding ranges to estimate a dollar value for each and calculate an overall percent of funding derived from private and government sources.

4.3 OTHER CONSIDERATIONS

This section discusses additional benefits anticipated by the SBV team.

4.3.1 Intellectual Property

Development of IP, another anticipated benefit of SBV associated with commercialization assistance, is evidenced in patents, copyrights, trademarks, and scientific publications.[54] Awardees and non-participants were asked to indicate the number of patents, copyrights, trademarks, and scientific/technical publications they applied for/submitted and received/published. In addition, we researched the U.S. Patent and Trademark website for patent applications and awards for awardees and non-participants in our sample (https://www.uspto.gov/patents-application-process/search-patents). We found that three awardees and three non-participants did not report applying for or receiving patents, but we found evidence they had received a patent in the U.S. Patent and Trademark website. Due to these inconsistencies and apparent measurement or recall errors, we have more confidence in the simpler metric of percent reporting the intellectual property than the counts.

Overall, 47% of awardees and 81% of non-participants applied for a patent, copyright, and/or trademark after receiving or applying for the SBV award (Table 14). On average, non-participants reported more patents, copyrights, trademarks, and scientific/technical publications applied for/submitted *or received/published* than awardees (however, these differences were not statistically significant). Since applying for SBV, non-participants reported *applying for/submitting* an average of 1.4 patents, 0.1 copyrights, 0.2 trademarks, and 0.75 scientific technical publications. In comparison, awardees reported *applying for/submitting* an average of 1.1 patents, zero copyrights, 0.4 trademarks, and 0.5 scientific technical publications (Table 14).

Table 14: Number of Patents, Copyrights, Trademarks, and/or Scientific Publications Applied for/Submitted

Number Applied for/Submitted	All SBV Awardees (n=43)		Non-participants (n=16)	
	Range	% Responding > 0	Range	% Responding > 0
Patents	0-8	42%[a]	0-6	81%
Copyrights	0-0	0%[a]	0-2	19%
Trademarks	0-2	9%	0-1	25%
Patent, Copyright or Trademark	0-8	47%[a]	0-6	81%
Scientific/Technical Publications	0-3	35%	0-8	44%

[a] Statistically significantly different from non-participants at the 90% confidence level.

Overall, 33% of awardees and 44% of non-participants received or published a patent, copyright, and/or trademark after receiving/applying for the SBV award. Non-participants reported *receiving/publishing* an average of 1.25 patents, 0.2 copyrights, 0.25 trademarks, and 2.1 scientific/technical publications, more than awardees except for trademarks (statistically

[54] 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.

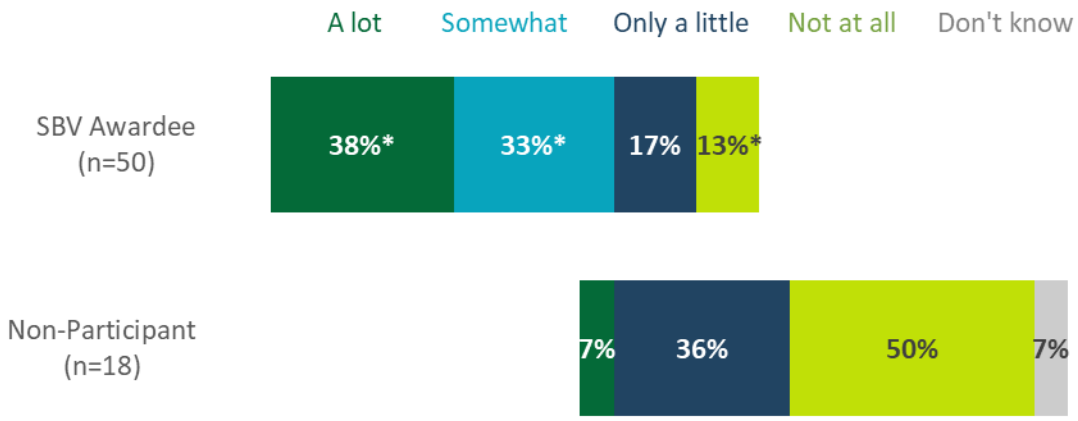
significant at the 80% confidence level). Awardees reported *receiving/publishing* an average of 0.3, zero copyrights, 0.1 trademarks, and 0.4 scientific/technical publications (Table 15).

Table 15: Number of Patents, Copyrights, Trademarks, and/or Scientific Publications Received/Published

Number Received/Published	All SBV Awardees (n=43)		Non-participants (n=16)	
	Range	% Responding > 0	Range	% Responding > 0
Patents	0-3	28%	0-8	44%
Copyrights	0-0	0%	0-2	13%
Trademarks	0-1	7%	0-2	19%
Patent, Copyright or Trademark	0-3	33%	0-8	44%
Scientific/Technical Publications	0-4	23%	0-9	44%

When asked to what extent the SBV application experience contributed to the reception or publication of patents, copyrights, trademarks, and/or scientific/technical publications, 38% of awardees said the SBV process had contributed "a lot" and 33% said it had contributed "somewhat." Only one non-participant reported that the experience contributed "a lot;" the majority of non-participants said it contributed "not at all" (50%) or "only a little" (36%).

Figure 13: Contribution of SBV Experience to the Development of Intellectual Property



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

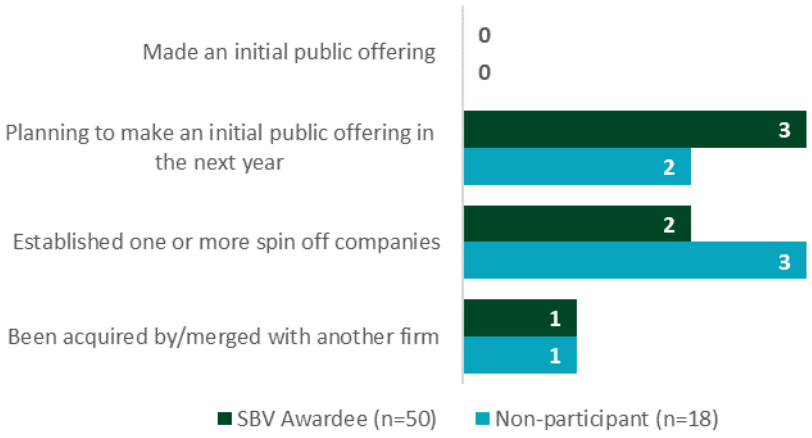
Survey respondents were also asked if their company had experienced public offerings, spin-offs, acquisition, or mergers. None of the respondents had made an initial public offering yet. However, 11% of non-participants said they planned to make an initial public offering in the next year, compared to 6% of awardees (Table 16). A larger proportion of non-participants (17%) than awardees (4%) said they had established one or more spin-off companies, while a statistically similar proportion of non-participants (5%) and awardees (2%) reported being acquired by or merging with another firm.

Table 16: Initial Public Offerings, Spin-Offs, and Mergers [1]

	All SBV Awardees (n = 50)	Non-participants (n=18)
Planning to make an initial public offering within a year	6%	11%
Established one or more spin-off companies	4%	17%
Been acquired by/merged with another firm	2%	6%
Made an initial public offering	0%	0%
Responded "yes" to one of the above actions	10%	22%

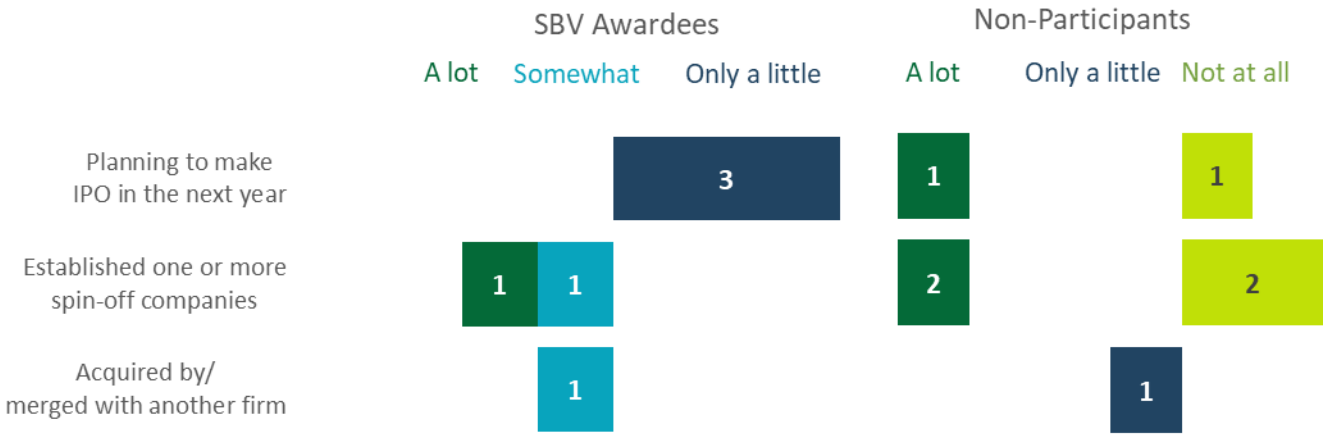
[1] All SBV Awardees are not significantly different from non-participants at the 90% confidence level.

Figure 14: Initial Public Offerings, Spin-Offs, and Mergers By Count



Respondents who indicated any corporate development (Figure 14) rated the extent to which the SBV experience contributed to that development (Figure 15).

Figure 15: Contribution of SBV Experience to Corporate Development (Count of Responses)



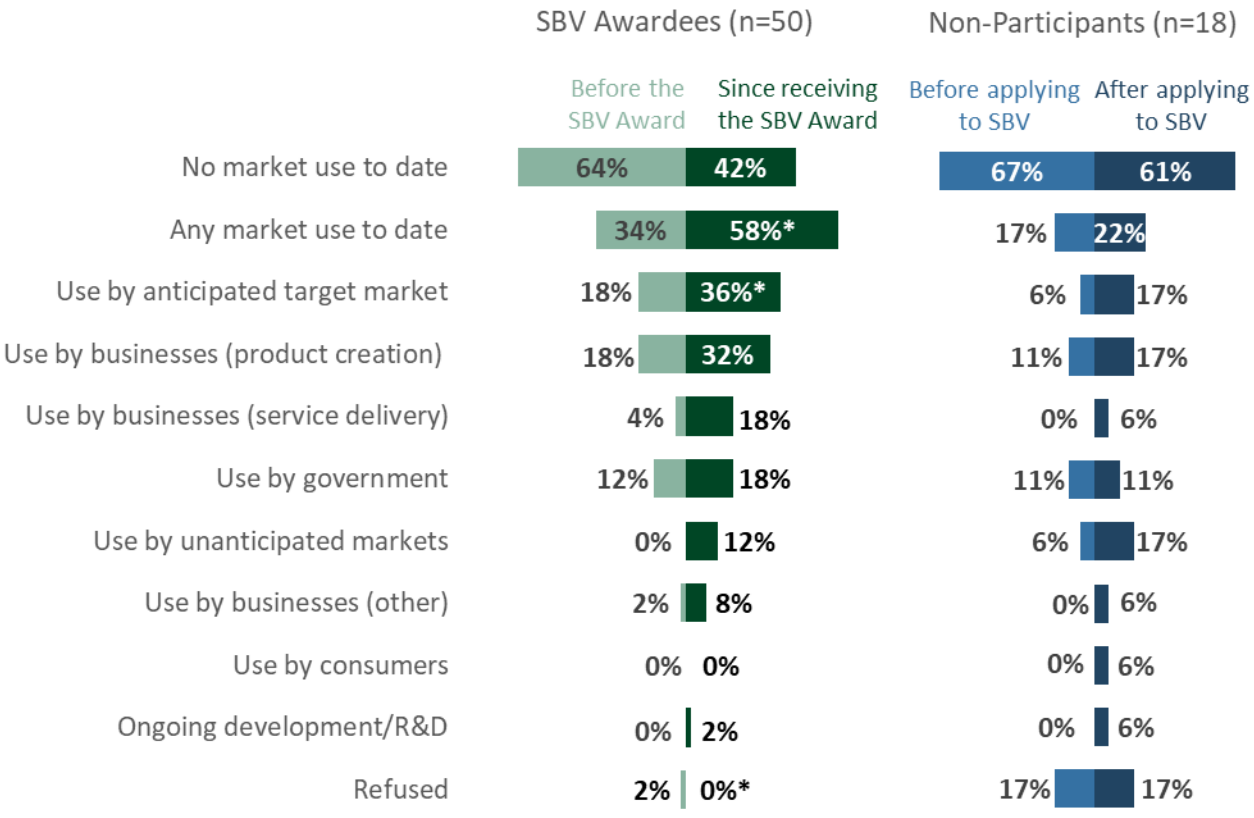
Section 5 Findings: Goal 4 – Commericalization Success

This section discusses findings related to the pilot's fourth goal, "commercialization success."

5.1 Target Market of Technology

SBV awardees experienced a statistically significant increase in the percentage of firms whose technology was used by a market from before the SBV award to after (increasing from 34% to 58% of awardees), while the increase experienced by non-participants was not statistically significant (increasing from 17% to 22%). The difference in increases between SBV awardees (24 percentage points) and non-participants (5 percentage points) were statistically significant. While use of SBV-related technology increased in every market sector and segment in the period after applying to or receiving the SBV award, SBV awardees were statistically significantly more likely than non-participants to report use by the anticipated target market (36% compared to 17%; see Figure 16).

Figure 16: Use of SBV-Related Technology



* Statistically significantly different from non-participants at the 90% confidence level.

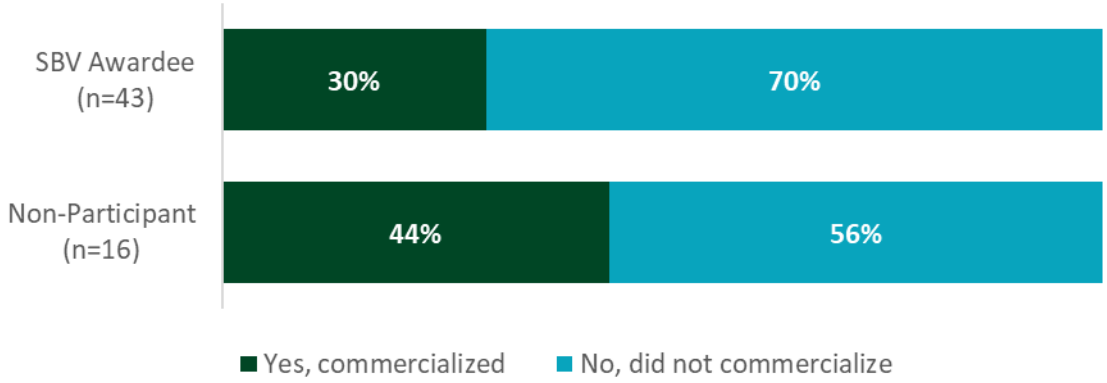
Table 17: Target Market for SBV Technology Prior to Application

Target Market	SBV Awardees (n = 50)	Non-participants (n = 18)
Renewables	9	4
Fuel cells	6	0
Electricity	3	3
Automobile	3	1
Commercial & Industrial	3	1
Biofuels	2	1
HVAC	2	0
Metals	2	0
Military	2	0
Polymers	2	0
Batteries and storage	2	2
Building envelope/windows	1	1
Electronic end uses	1	1
Hydropower	1	1
Manufacturing	1	1
Water treatment	1	0
Natural gas	0	1
Other	9	1

5.2 Commercially Launched Technologies and Sales

Among respondents whose firms are continuing their involvement with SBV-related technology, 30% of awardees and 44% of non-participants reported beginning commercialization (the difference is not statistically significantly different). Considering all survey respondents, 26% of all awardees and 39% of all non-participants reported beginning commercialization of their SBV technology (not a statistically significant difference). However, we note that 58%% of awardees reported that their technology is being used by a market (see Section 5.1). Section 5.2.2 provides some insights into technologies that are being used in the market but have not realized sales, which may account for this apparent discrepancy between market use and commercialization.

Figure 17: Commercialization of SBV-Related Technology



When asked to describe commercialization activities and outcomes, SBV awardees were most likely to mention adoption, production, and sales (4) and advancements in performance, technology, and modeling (2) (Table 18).

Table 18: Description of Firm's Commercialization Activities

Commercialization Activities	SBV Awardees (n = 13)	Non-Participants (n=7)
Adoption, production, and sales/application of technology	4	1
Advancements in performance, technology, and modeling	2	2
Licensing technology	1	1
Active in sales	1	1
Expanded company	1	0
Expanded portfolio	1	0
Piloting demonstrations of technology	1	0
International partnerships	0	1
Don't know	2	1

Awardees most commonly cited the impact of the SBV award on the commercialization process to be an improved understanding of production yield and reduction in costs (3), access to analytical information and R&D technology (3), and assistance in getting the product to market (3). One non-participant reported that the SBV application process helped to establish early adopters and production demand, but most non-participants (4) said that the SBV application did not contribute at all to the commercialization process (Table 19).

Table 19: Contribution of SBV to Firm's Commercialization Activities

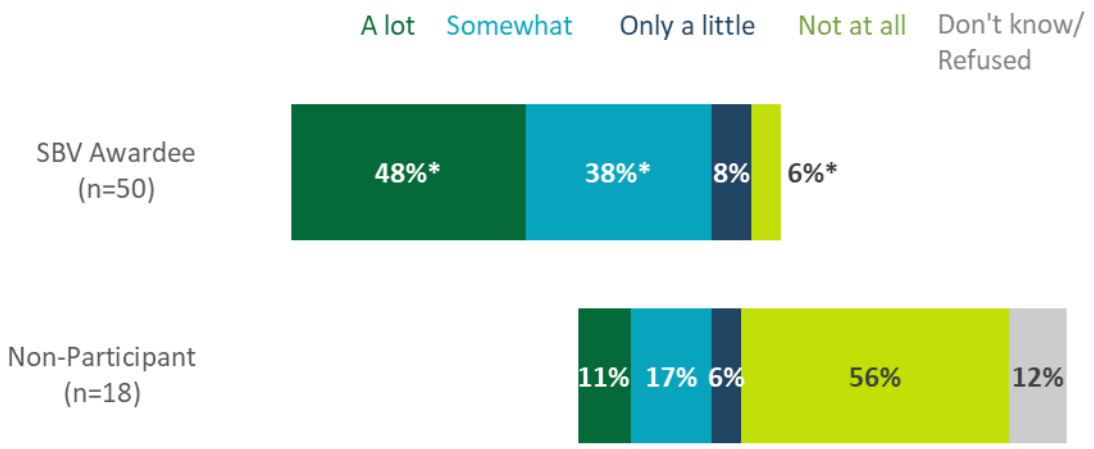
SBV Award/Application Contribution	SBV Awardees (n = 13)	Non-Participants (n=7)
Improved understanding of production yield and reduction in costs	3	0
Access to analytical information and R&D technology	3	0
Assisted in getting the product to market	3	0
Redefined focus	1	0
Improve downstream processing/product piloting	1	0
Establish early adopters and production demand	0	1
No contribution	0	4
Don't know	2	2

Several awardees provided details about the benefits and impacts of SBV on their commercialization activities.

- *SBV provided better understanding of our processes to improve yield and reduce costs.*
- *The SBV allowed us to optimize downstream processing, helping us advance our commercialization.*
- *SBV gave us key analytical information and equipment to develop technology.*
- *The SBV helped us overcome technical challenges related to materials manufacturing necessary to scale.*
- *They helped push us over the top for commercialization. They helped us narrow the focus, which was very helpful.*
- *The SBV was absolutely critical to this innovation -- it likely would not have gotten to market otherwise.*
- *SBV provided better understanding of our processes to improve yield and reduce costs.*
- *Our SBV was a validation of our technology that helped customers and potential customers understand our product and adopt it with confidence.*

Nearly nine in ten SBV awardees considered the SBV experience to have contributed "a lot" (48%) or "somewhat" (38%) to the commercialization of their SBV-related technology. By comparison, more than half of non-participants said the application experience contributed "not at all" to the commercialization of respondents' SBV-related technology (Figure 18).

Figure 18: Extent of Contribution of SBV Experience to Commercialization



*Statistically significantly different from non-participants at the 90% confidence level.

5.2.1 Sales (Exclusive of Licensing Fees)

Prior to SBV application, a similar proportion of SBV awardees and non-participants (20% and 17%) reported sales of products, services, processes, and other sales of their SBV-related technology (such as rights to technology and licensing). Since applying to SBV or SBV award, more SBV awardees (30%) reported sales of their SBV-related technology than non-participants (17%), a difference that is not statistically significant (See Figure 19). Although there are more SBV awardees reporting sales after application (30%) than before application (20%), the difference is not statistically significant.

Figure 19: Percent With Sales Before and After Award Announcement or Application

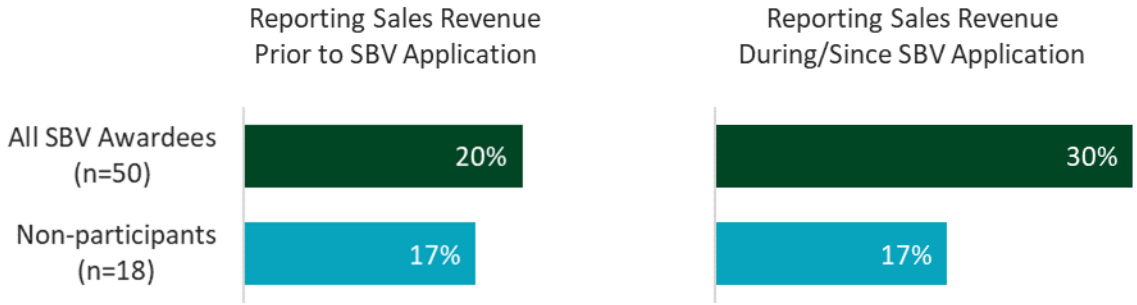
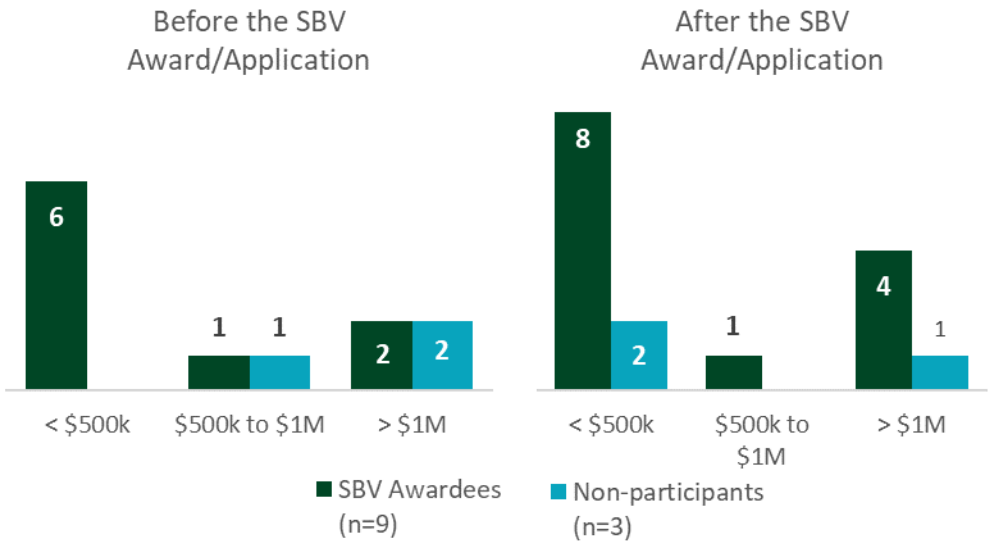


Figure 20: Sales Before and After SBV Award or Application (Respondents with pre-SBV sales Only)



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

For awardees and non-participants who reported sales, 13 awardees and three 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 $249,999
- $250,000 to $499,999
- $500,000 to $749,999
- $750,000 to $999,999
- $1,000,000 to $1,249,999
- $1,250,000 to $1,449,999
- $1,500,000 to $1,749,999
- $1,750,000 to $1,999,999
- $2,000,000 to $2,249,999
- $2,250,000 to $2,499,999
- $2,500,000 to $2,749,999
- $2,750,000 to $2,999,999
- $3,000,000 to $3,249,999
- $3,250,000 to $3,499,999
- $3,500,000 to $3,749,999
- $3,750,000 to $3,999,999
- $4,000,000 to $4,249,999
- $4,250,000 to $4,499,999
- $4,500,000 to $4,749,999
- $4,750,000 to $4,999,999
- $5,000,000 to $5,499,999
- $5,500,000 to $5,999,999
- $6,000,000 to $6,499,999
- $6,500,000 to $6,999,999
- $7,000,000 to $7,499,999
- $7,500,000 to $7,999,999
- $8,000,000 to $8,499,999
- $8,500,000 to $8,999,999
- $9,000,000 to $9,499,999
- $9,500,000 to $9,999,999
- $10,000,000 to $10,999,999
- $11,000,000 to $11,999,999
- $12,000,000 to $12,999,999
- $13,000,000 to $13,999,999
- $14,000,000 to $14,999,999
- $15,000,000 and up

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 20 displays these estimated sales ranges by type of sale and overall. The sum of estimated sales across awardees who reported making sales ranges from $9.6 million to $10.8 million, with an average value of $200,000 to $224,000 per awardee respondent. In comparison, the sum of estimated sales across non-participants who reported making sales ranges from $5.1 million to $5.4 million,[55] with an average value of $284,000 to $297,000 million per non-participant respondent. Average sales for non-participants should be interpreted with caution as it is based on three respondents. Two of the three respondents reported sales less than $250,000 while the third reported sales of over $5,000,000, resulting in the high average sales for non-participants.

Table 20: Estimated Sales ($ thousands)*

Sales	SBV Awardees (n = 47)	Non-participants (n = 18)
Total Reported Sales	$9,605 – 10,775	$5,105 – 5,350
Average Sales, all respondents[1]	$200 – 224	$284 – 297

*Excludes licensing fees

[1] For average sales, respondents who reported no sales were given a value of $0 and "don't know" responses were excluded.

The team examined sales by round and several factors, including technology type, starting TRL, commercialization experience, and size of SBV award (Appendix C) and found no differences in rates of sales between awardees and non-participants for any rounds. However, we did find associations with starting TRL and prior commercialization experience. Awardees with starting TRLs in the Validation/Commercialization stages were more likely to achieve sales post SBV award. In addition, awardees with prior commercialization experience were more likely to achieve sales than those without.

Awardees and non-participants who reported that their technology was in use in the market but did not report sales data were asked to provide details (Table 21). The most common explanation among awardees is that the technology is either at the marketing or prototype stage or a component of the technology is in use in other markets.

[55] The maximum sales amount range selected by two of the three non-participants was less than $250,000. The remaining non-participant selected sales of $5,000,000 to $5,249,999.

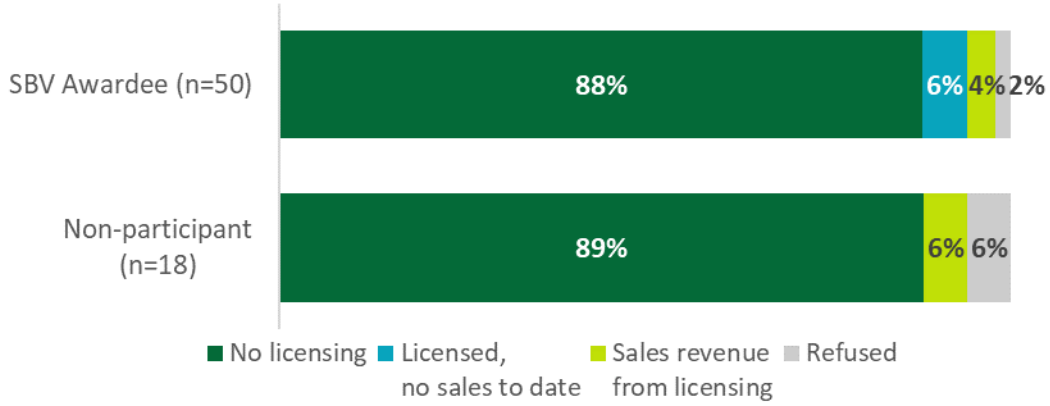
Table 21: SBV Technology is in Use in the Market but Without Sales Revenue to Date

Reasons	SBV Awardees (n = 11)	Non-participants (n = 3)
Technology is in marketing stage with samples or prototypes	4	0
Technology (or a component of the technology) is in use in other market(s)	3	0
Tested technology but it is not commercially viable	1	0
Firm is researching applications for the technology	1	0
A competing product(s) is already in other markets	1	0
Firm is waiting for funding	1	0
Technology is in the development stage	0	1
DK/Refused	0	2

5.2.3 Sales (Licensing)

Licensing was rare. Eighty-eight percent of awardees and 89% of non-participants reported that their firm had not done any licensing of the SBV or SBV-related technology. One in ten awardees had licensed their technology; 4% had sales to date (Figure 21).

Figure 21: Licensing of SBV-Related Technology



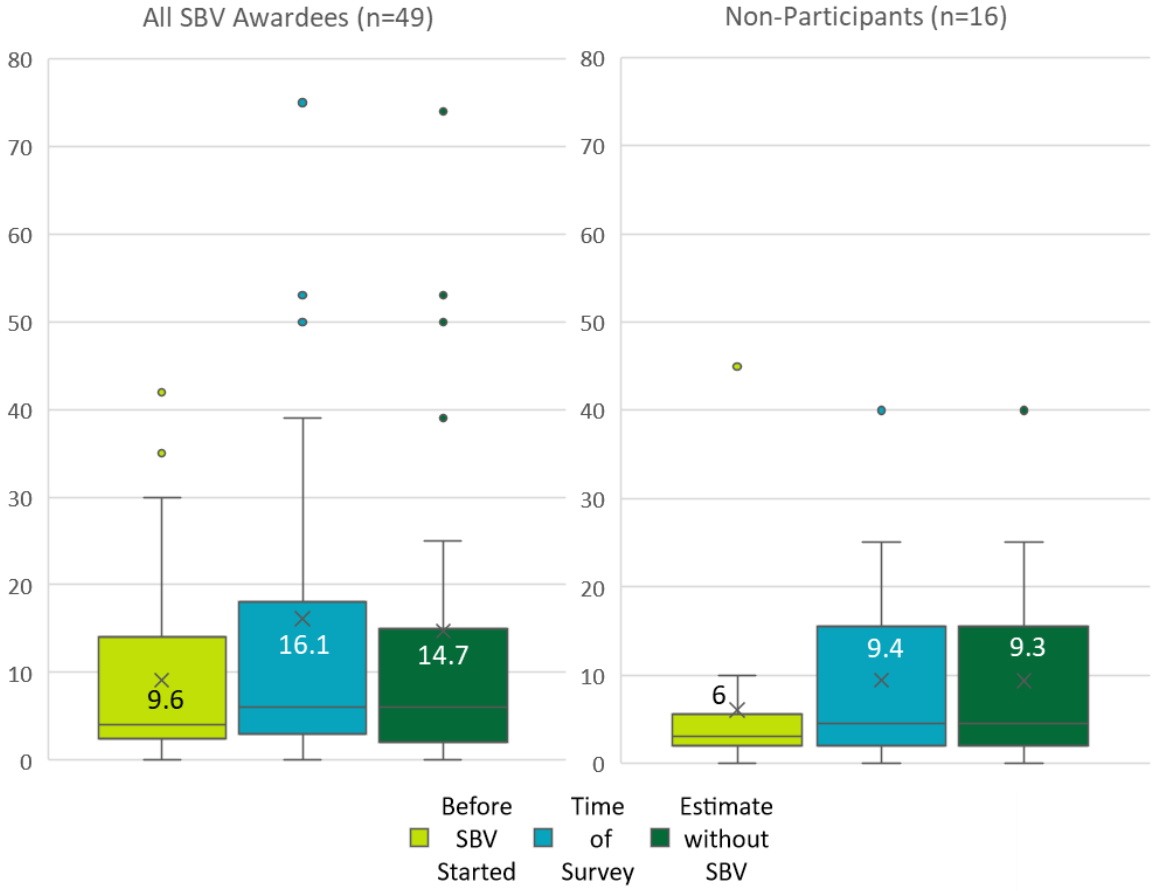
Of the two SBV awardees whose firms obtained sales revenue from licensing, one firm reported sales of less than $100,000 and the other reported sales of $100,000 to less than $250,000. The non-participant whose firm obtained sales revenue from licensing reported sales of $1,000,000 to $2,500,000.

5.3 Employment Effects from Technology

Employment effects are another anticipated later outcome of the SBV pilot. Figure 22 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 company[56] (6.0 employees) was smaller than the average awardee company[57] (9.6 employees). On average, awardee companies nearly doubled in size during the SBV Lab contracts, from 9.6 to 16.1. Non-participant companies also increased during this same period, from 6 to 9.4. Awardees estimated that their employment would have been lower had their firm not undertaken the SBV project (14.7 on average). On average, non-participants estimated their firm would have had a similar number of employees (9.3) as the employ today (9.4) had they not applied to SBV. These findings suggest that awardees believed the SBV contracts positively impacted the size of their companies.

Figure 22: Number Employed at Respondent's Firm Before and After SBV [1]



[1] X represents the mean of the number of people employed, the whiskers represent the number of people employed outside the middle 50%, and the dots above whiskers represent outliers.

[56] We excluded one very large non-participant outlier - a company with over 300 employees - from the mean. This company was also the only non-participant respondent to report undergoing a merger or acquisition since applying to the SBV program.

[57] We excluded one very large awardee outlier – a company that reported currently employing 700 people. This company was also the only awardee respondent to report undergoing a merger or acquisition as a result of the SBV program.

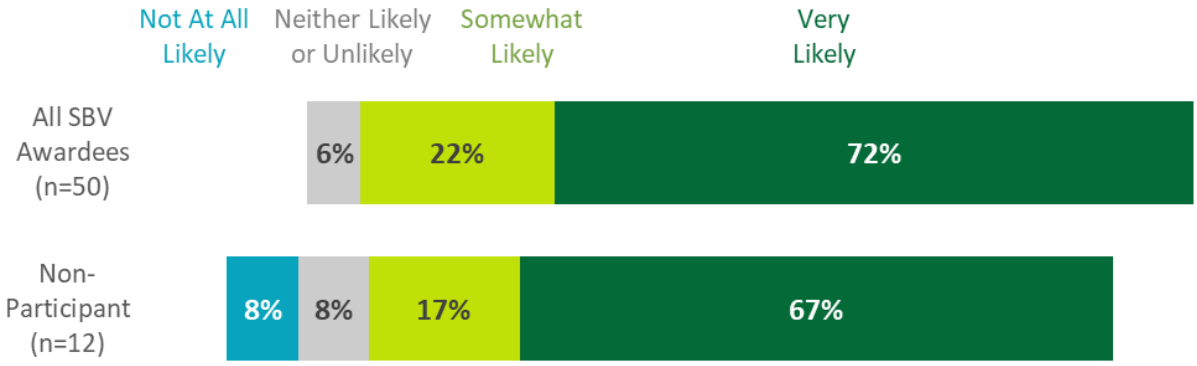
Section 6 Findings: Goal 1 - Engagement of Small Businesses

This section discusses findings related to the pilot's first goal, "engagement of small businesses." These findings augment those presented in the 2016 and 2018 SBV evaluation reports.[58]

6.1 Proportion Interested in Repeated Work with Labs

Nearly three-quarters of all SBV awardees (72%) and 67% of non-participants reported being very likely to work with the Labs again (Figure 23).[59] While awardees and non-participants shared a statistically similar level of satisfaction, this finding suggests that the experience made a positive impression on most awardees. One non-participant (8%) reported they were unlikely to work with the Labs again.

Figure 23: Likelihood that You Will Work with the Labs Again



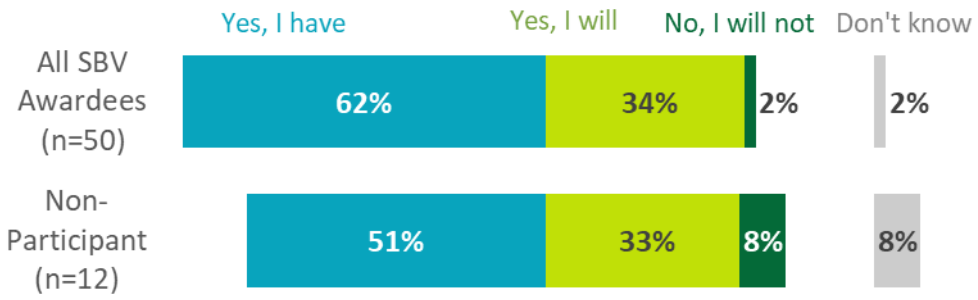
6.2 Proportion Recommending to Colleagues

Ninety-six percent of SBV awardees said they had recommended or will recommend that their colleagues work with the Labs (Figure 24). A statistically similar proportion of non-participants (83%) also reported they would recommend that their colleagues work with the Labs.

[58] Research Into Action, NMR, and Gretchen Jordan. 2016. Baseline and Process Evaluation of Small Business Vouchers Pilot. DOE/EE-1574. SBV Baseline and Process Evaluation.
Research Into Action, NMR and Gretchen Jordan. 2018. Early Stage Outcomes and Impacts, Round 1, 2, & 3 Awardees DOE/EE-1576. Early Stage Outcomes Evaluation

[59] 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 24: Respondent Recommendations to Colleagues or Other Small Businesses that They Work with the Labs



Section 7 Metrics Summary, Conclusions, and Recommendations

Evaluation findings spanning three evaluation reports provide evidence that the SBV pilot achieved its four goals.[60] However, we note that the evidence for goal 3 (commercialization assistance) and goal 4 (commercialization success) is more mixed. We have relatively strong evidence from the perspective of the participants and self-reported attribution to SBV impacts, but we have weaker statistical evidence when we include analysis with a comparison group (i.e., due in part to a small sample of responding non-participants).

7.1 Metrics Summary

Table 22 provides a summary of the key outcomes and indicators of the evaluation, organized by goal.

Goal 1: Lab engagement of small businesses

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 RFAs (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. Two thirds of applicants were firms with less than six employees and over half (55%) of applicants had not previously worked with the labs.

SBV awardees reported high levels of satisfaction with the application portal and process, contracting, and the quality of work with the labs. In addition, 77% of awardees reported they developed new relationships due to SBV, 94% of awardees are likely to work with the labs again, and 96% recommend working with the labs to their colleagues.

Goal 2: Lab awareness of small business needs

The labs learned about the technology-related needs of over 1,200 small businesses through RFAs submitted by those businesses. 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.

[60] The three evaluation reports are the current report as well as the Baseline Report and the Early Stage Outcomes Report:
Research Into Action, 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.
Research Into Action, NMR and Gretchen Jordan. 2018. Early Stage Outcomes and Impacts, Round 1, 2, & 3 Awardees DOE/EE-1576. Early Stage Outcomes Evaluation.

Goal 3: Lab commercialization assistance

The 14 labs participating in the pilot contracted with 114 small businesses to provide them with a total of approximately $22 million in assistance, supported by DOE's SBV funding across the nine EERE program offices. The assistance provided by the labs was largely in the form of technical assistance.

While the vast majority of awardees (86%) reported that their technology had advanced at least one stage of development (TRL advancement), awardees demonstrated similar progress over time as non-participants in the development of their technologies: 72% of non-participants reported their technology had advanced at least one stage of development (not a statistically significant difference). However, SBV awardees experienced a statistically significant increase in the percentage of firms whose technology was used by a market from before the SBV award to after (increasing from 34% to 58% of awardees), while the increase experienced by non-participants was not statistically significant (increasing from 17% to 22%). SBV awardees were statistically significantly more likely than non-participants to report use of their technology by the anticipated target market (36% compared to 17%).

In addition, the analysis suggests SBV played a role in market pivots for awardees who needed to pivot their technology to new markets, some of which awardees had never considered. Ten of 12 awardees (83%) who pivoted indicated that their SBV experience had at least a little influence on their pivot to a new market, with two-thirds indicating somewhat or a lot of influence (a statistically significant difference from non-participants). However, we note that there is not a statistically significant difference in the percent of awardees and non-participants who pivoted to a new market.

Sixty percent of awardees received follow-on funding compared to 56% of non-participants (not a statistically significant difference). As a group, participants received more follow-on funding than non-participants, but the average amount of follow-on funding was not statistically significantly different (with an average of $1.1 million to $1.2 million per awardee and an average of $1.9 to $2.0 million per non-participant). In addition, the share of follow-on funding from private sources appears to have increased for awardees since they received their SBV award compared to before the SBV award, while the share for non-participants declined.

We also note that while responding non-participants reported higher levels of development of intellectual property (IP) (patents, copyrights, or trademarks and scientific publications), the differences are not statistically significant. Seventy-one percent of awardees reported that SBV contributed somewhat or a lot to their development of IP.

Goal 4: 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.

Thirty percent of awardees achieved sales of their SBV-related technology, compared to 17% of non-participants (the differences are not statistically significant). As a group, participants reported more sales than non-participants but the average sales for all participants and all non-participants

were not statistically significantly different (with an average value of $200,000 to $224,000 per awardee respondent and average value of $284,000 to $297,000 per non-participant respondent).

We note that the survey-based metrics of *commercialization* are varied. In contrast to reporting sales, when asked whether their technology had been commercialized, 26% of responding awardees and 39% of responding non-participants reported they had (not a statistically significant difference). While, as noted earlier, 58% of responding awardees and 22% of responding non-participants reported their technology was in use by a market. When asked how their technologies were used in the market while not reporting sales, the most common explanation among awardees is that the technology is either at the marketing or prototype stage or that a component of the technology is in use in other markets (see Section 5.2.2).

On average, awardee companies nearly doubled in size during the SBV Lab contracts, from 9.6 to 16.1. Non-participant companies also increased in size during this same period, from 6 to 9.4; the differences between awardees and non-participants is not statistically significantly different. Awardees estimated that their employment would have been lower had their firm not undertaken the SBV project (14.7 on average), while non-participants estimated their firm would have had a similar number of employees (9.3) as the employ today (9.4) had they not applied to SBV. This finding suggests that awardees believed the SBV contracts positively impacted the size of their companies.

Table 22: SBV Goals and Evaluation Metrics

Metric	Indicator	Finding
Goal 1: Lab Engagement of Small Businesses		
Lab outreach and SBV Central Application Portal (CAP)	Increased lab outreach to small business	Labs activated their own network and expanded networks for outreach. Small businesses in 46 states and the District of Columbia submitted RFAs.[1]
	# of SBV applicants	1,200 SBV applicants[1]
	# of SBV registered users to SBV's CAP website	2,400 registered users[1]
	# of small firms (under ten employees) that applied	2/3 of applicants[1]
	% applicants that had not worked with labs previously	55% of applicants[1]
SBV opportunity notice and application process	Application process and funding opportunity notice	94% of awardees reported their expectations of the overall funding opportunity notice were met or exceeded; 81% of awardees reported the application process was easier than applying for other federal awards[3]
	Satisfaction with the Central Assistance Portal (CAP)	78% of awardees said the SBV CAP was easy or very easy to navigate[3]
SBV contracting process	Satisfaction with contracting: expectations were met or exceeded	91% of awardees' expectations were met or exceeded with the amount of time it took to develop the statement of work (SOW); 88% or more of awardees reported their expectations were met or exceeded for all other aspects of contracting[3]
SBV technical assistance	Satisfaction with quality of work provided by labs: expectations were met or exceeded	95% of awardees were satisfied with the overall voucher project experience; over 90% were satisfied with quality of the work, facilities, and staff expertise[3]
Relationships	New relationships formed	77% of awardees reported they developed new relationships[3]
Proportion interested in repeated work with Lab	Proportion very and somewhat likely to work with a Lab again	94% of awardees likely to work with a Lab again[#]
Proportion recommending to colleagues	Proportion recommending to colleagues	96% of awardees recommended to colleagues[#]
Goal 2: Lab Awareness of Small Businesses Needs[#]		
Lab awareness of small business technical needs	Lab pilot manager awareness of small business needs	Interviewed lab pilot managers commonly attributed the pilot to increasing their knowledge of small business; Pilot managers reported awarding vouchers to

Metric	Indicator	Finding	
		unanticipated innovations not encompassed by their technology road maps.[1]	
	Lab awareness of small business needs	Over 1,200 RFAs submitted by small businesses; extensive pilot outreach activities; point-of-contact service, through which they engaged with registered website users[1]	
Goal 3: Commercialization Assistance[#]		**Awardees**	**Non-participants**
Technology readiness (TRL) advancement	Advanced at least one stage of development	86%	72%
Market pivot	Pivoted to a new market (somewhat or full pivot)	24%	33%
	SBV influenced the pivot	10 of 12*	1 of 6
Follow-on funding obtained	Received or invested follow-on funding	60%	56%
	SBV influenced source or amount of follow-on funding	54%*	11%
	Total follow-on funding	$53 to $55 million	$33 to $34 million
	Average follow-on funding	$1,127,000 – 1,178,000	$1,947,000 – 2,000,000
	Percent of follow-on funding from private sources, pre-SBV	50%	48%
	Percent of follow-on funding from private sources, post-SBV	59%	35%
Intellectual property and business developments	Percent who received a patent, copyright, or trademark	23%	44%
	Percent with scientific or technical publication	33%	44%
	SBV contributed to development of intellectual property (somewhat or a lot)	71%*	7%
	Public offering (made or planned), spin off, acquired by another firm	10%	22%

Goal 4: Commercialization Success	**Awardees**	**Non-participants**

Metric	Indicator	Finding	
Market for the technology	Percent of firms with a technology used by any market segment, pre-SBV	34%	17%
	Percent of firms with a technology used by any market segment, pre-SBV	58%*	22%
	Use by anticipated target market, post-SBV	36%*	17%
Technologies commercially launched	Commercialized the SBV technology	26%	39%
	SBV contributed to commercialization	94%*	33%
	Achieved sales of SBV-related technology	30%	17%
	Total sales, post-SBV	$9.6 million to $10.8 million	$5.1 million to $5.4 million
	Average sales, post-SBV	$200,000 – 224,000	$284,000 – 297,000
Employment effects from technology	Average number of employees, time of SBV award	9.6	6.0
	Average number of employees, post-SBV award	16.1	9.4

* Statistically significantly different from non-participants at the 90% confidence level.
# When multiple evaluations obtained a given metric statistic, this table provides the statistic from the most recent evaluation.
[1] 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.
[2] RIA, NMR and Gretchen Jordan. 2018. Small Business Vouchers. Evaluation. Round 2 Awardees Preliminary Results. DOE/EE-1576. Round 2 Awardees Preliminary Results
[3] RIA, NMR and Gretchen Jordan. 2018. Early Stage Outcomes and Impacts, Round 1, 2, & 3 Awardees DOE/EE-1576. Early Stage Outcomes Evaluation

7.2 RECOMMENDATIONS

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

1. Consider encouraging the labs to continue outreach to and develop partnerships with small businesses. There is high interest from small businesses, awardees and non-participants alike, to work with the labs. Awardees clearly indicated that their work with the labs helped them to commercialize their technology, receive follow-on funding, develop intellectual property, and determine when and how to pivot to new markets.
2. Consider offering a program to provide small businesses access to the labs. Continue to provide a simple and clear process whereby a small business can approach the labs with a request, have its request assessed on its merit, be matched with an appropriate lab and PI, and have a relatively simple contract developed and executed relatively quickly

3. Consider whether the SBV-developed form Cooperative Research and Development Agreement (CRADA) could serve as a template for streamlining standard CRADAs. 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 by developing short, standardized contracts for awardees: a short-form CRADA. Awardees' expectations about the SBV contracting process were almost all met or exceeded.
4. Consider whether the SBV-developed application processes could be continued. For the SBV pilot, small businesses completed a short (about five-page) request for assistance, submitted the request through an application portal. The majority of SBV Awardees found that the application process and funding opportunity notice met or exceeded their expectations.
5. If comparison groups are to be included in the evaluation design, early discussions among evaluators and program staff should confirm the availability of the necessary data for fair and credible comparisons. This could require helping program staff understand the evaluation challenges, confirm that the program is willing and able to collect the additional data needed, and find ways to ensure that both participant and comparison group cooperation with data collection will be at least moderately high over the course of the evaluation.

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.[61] The table below compares the commercialization stages used in the SBV survey to TRLs.

[61] 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 8. Initial sales (sales to early adopters) 9. Diversification/market success	**TRL 10 production and sales:** EERE has used this added TRL

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 less than 15 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 DOE National 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).

1 Yes, awarded SBV voucher

2 No, not awarded SBV voucher (exit questionnaire)

97 Don't Know

98 Refused (exit questionnaire)

SC1a. [IF SC1 = 97 (DK] Please provide the name and email address of the person at your firm who is likely to be most knowledgeable about the SBV voucher.

[Open-ended response & exit questionnaire]

SC2. What was your role with the firm at the time it received the SBV award? Please select all that apply. [MULTIPLE RESPONSE]. [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 (Go to SC2a)

SC2a. [IF SC2 = 5 (None of the above)] Please provide the name and email address of the person at your firm who is likely to be most knowledgeable about the SBV voucher.

[Open-ended response & exit questionnaire]

B.1.3 Your SBV Experience

Q1. Has your firm completed its SBV research project with the lab? (Please select best response.) [~SBIR30]

1. Yes, research project completed
2. No, research project still underway
3. No, research terminated prior to completion of the SBV project

97. Don't know

98 Refused

Q2. Is your firm continuing its involvement with its SBV technology? [SINGLE RESPONSE]

1. Yes, firm's involvement continues
2. No, firm has discontinued its efforts related to this technology

97. Don't know

98 Refused

Q3 [IF Q2 = 2, DISCONTINUED] Which of the following were reasons your firm has discontinued its efforts related to this technology? Please check all that apply. [MULTIPLE RESPONSE] [~SBIR31]

1. Technical failure or difficulties	2. Market demand too small
3. Level of technical risk too high	4. Not enough funding
5. Company shifted priorities	6. Principal investigator left
7. Project goal was achieved (for example, a prototype was delivered)	8. Licensed to another company
9. Product, process, or service not competitive	10. Inadequate sales capability
11. Another firm got to the market before us	12. Other (please specify):
97. Don't know	98 Refused

Q4. [IF Q2 = 2, DISCONTINUED] Which of these was the primary reason for discontinuing efforts relating to this technology? [pipe in reasons marked "yes" in Q3 for respondents to choose from; SKIP OF Q3 = 97 OR 98) [SINGLE RESPONSE] [~SBIR32]

Q5. [IF Q2 = 2, DISCONTINUED] Briefly, how did your firm's SBV experience influence, if at all, your decision to discontinue efforts related to this technology? (If no influence, please write None)

[OPEN ENDED]

Q6 [IF Q1=1, RESEARCH COMPLETED] Please check the quarter in which your firm completed its SBV research project with the lab. [RADIO BUTTONS IN EACH CELL. SINGLE RESPONSE]

Year/Quarter	Q1 (Jan-Mar)	Q2 (Apr-Jun)	Q3 (Jul-Sep)	Q4 (Oct-Dec)
2016				
2017				
2018				
2019				

Q7. [ASK ALL] Which of the following describe any use of your firm's SBV technology, including the time before you received the SBV award and since receiving the SBV award (Please select all that apply.) [RADIO BUTTONS IN EACH CELL. MULTIPLE RESPONSE IN EACH COLUMN] [*overlap with some of SBIR 30*]

Use of your firm's SBV technology	Before the SBV award	Since receiving the SBV award
1. No market use to date		
2. Use by anticipated target market		
3. Use by unanticipated market sectors/segments		
4. Use by consumers (individuals, households)		

5. Use by businesses in the creation of their products (as an input, or part of a process)		
6. Use by businesses in the delivery of their services		
7. Use by businesses in a capacity other than above		
8. Use by government		
9. Other (Please specify:_____)		
97. DK		
98. Ref		

Q7a. Briefly, please describe the target market for your SBV technology, before the SBV award. [OPEN-ENDED]

Q7b. Have you somewhat or fully pivoted from that target market to a new target market? [SINGLE RESPONSE]

Yes, somewhat pivoted to a new target market
Yes, fully pivoted to a new target market
No
DK
Refused

Q7c. [IF YES TO Q7b] Briefly, please describe the new target market for your SBV technology. [OPEN-ENDED]

Q7d. . [IF YES TO Q7b] Briefly, how has your firm's SBV experience influenced, if at all, the markets you target for your SBV technology?

[OPEN-ENDED]

Q8. [ASK ALL] Please indicate the stage of development/commercialization that best describes your SBV innovation today and at the time of SBV award. [CONSTRAIN TO A SINGLE RESPONSE IN EACH COLUMN]

Stage of development / commercialization	Today	At time of SBV award
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/sales beyond early adopters		

Q8a. [ASK IF Q8 STAGE OF DEVELOPMENT TODAY < AT TIME OF SBV AWARD] Why is your innovation at an earlier stage of development/commercialization now compared to at the time of SBV award? [ADD TEXT BOX FOR RESPONSE]

Q9. [SKIP IF Q2 = 2, DISCONTINUED] Has your firm commercialized (made any product/process/service sales of) its SBV technology? [SINGLE RESPONSE]

1. Yes
2. No

97. DK

98. Ref

Q10. [IF Q9 = 1 (YES COMMERCIALIZE)] Please briefly describe your firm's commercialization activities, outcomes, and how SBV contributed to that, if at all. [ADD TEXT BOX FOR RESPONSE]

Q11] Please indicate the extent to which the SBV experience contributed to the commercialization of your SBV technology.

1. Not at all	2. Only a little
3. Somewhat	4. A lot
97. DK	98. Ref

Q12. [SKIP IF Q2 = 2, DISCONTINUED] Please give the number of patents, copyrights, trademarks and/or scientific publications for the SBV technology developed since receiving the SBV award. Enter numerals. If none, enter 0 (zero). [SBIR39]

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

Q13. [ASK IF ANY NON-ZERO VALUES ENTERED IN Q12] Please rate the extent to which the SBV experience contributed to these patents, copyrights, trademarks, or publications.

1. Not at all
2. Only a little
3. Somewhat
4. A lot

97. DK

98. Ref

Q14. [ASK ALL] 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				

Q15. [ASK IF ANY YES VALUES ENTERED IN Q14] Please rate the extent to which the SBV experience contributed to the above corporate developments.

MATRIX RESPONSE

Item	RESPONSE
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	

1. [RESPONSES 1, 2, 3, 4, DK goes in rows a, b, c, d.]Not at all
2. Only a little
3. Somewhat
4. A lot

97. DK

98. Ref

Q16. [ASK ALL] Which of the following describe any sales revenue (exclusive of licensing fees) your firm has received from its SBV technology? (Please select all that apply.) [MULTIPLE RESPONSE] [~SBIR35]

1. No sales revenue to date
2. Sales revenue prior to applying for the SBV award
3. Sales revenue during the SBV research project
4. Sales revenue after the SBV research was completed

97. DK

98. Ref

Q17 [IF Q7 = 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 (USE) AND Q16 = 1 (NO REVENUE)] Briefly, please explain why you reported in a previous response the SBV technology is in use in the market and also report no sales revenues to date.

[OPEN ENDED]

Q18 Intentionally omitted

Q19. [IF Q16=2, SALES PRIOR TO SBV] Please check the response that best describes the technology's sales revenues (exclusive of licensing fees) prior to your firm's SBV application? (Please read down the columns.) [SINGLE RESPONSE]

< $100k								
$100k to < $250k	$1M to < $1.25M	$2M to < $2.25M	$3M to < $3.25M	$4M to < $4.25M	$5M to < $5.25M	$7M to < $7.5M	$9M to < $9.5M	$12M to < $13M
$250k to < $500k	$1.25M to < $1.5M	$2.25M to < $2.5M	$3.25M to < $3.5M	$4.25M to < $4.5M	$5.5M to < $6M	$7.5M to < $8M	$9.5M to < $10M	$13M to < $14M
$500k to < $750k	$1.5M to < $1.75M	$2.5M to < $2.75M	$3.5M to < $3.75M	$4.5M to < $4.75M	$6M to < $6.5M	$8M to < $8.5M	$10M to < $11M	$14M to < $15M
$750k to < $1M	$1.75M to < $2M	$2.75M to < $3M	$3.75M to < $4M	$4.75M to < $5M	$6.5M to < $7M	$8.5M to < $9M	$11M to < $12M	$15M & up
								Don't know

Q20. [IF Q16=3 OR 4, SALES DURING OR AFTER SBV] Please check the response that best describes the total technology's sales revenues (exclusive of licensing fees) since your firm received its SBV award? (Please read down the columns.) [SINGLE RESPONSE] [~SBIR36b]

< $100k								
$100k to < $250k	$1M to < $1.25M	$2M to < $2.25M	$3M to < $3.25M	$4M to < $4.25M	$5M to < $5.25M	$7M to < $7.5M	$9M to < $9.5M	$12M to < $13M
$250k to < $500k	$1.25M to < $1.5M	$2.25M to < $2.5M	$3.25M to < $3.5M	$4.25M to < $4.5M	$5.5M to < $6M	$7.5M to < $8M	$9.5M to < $10M	$13M to < $14M
$500k to < $750k	$1.5M to < $1.75M	$2.5M to < $2.75M	$3.5M to < $3.75M	$4.5M to < $4.75M	$6M to < $6.5M	$8M to < $8.5M	$10M to < $11M	$14M to < $15M
$750k to < $1M	$1.75M to < $2M	$2.75M to < $3M	$3.75M to < $4M	$4.75M to < $5M	$6.5M to < $7M	$8.5M to < $9M	$11M to < $12M	$15M & up
								Don't know

Q21. [ASK ALL] Which of the following describe any funding your firm has received for the development and/or commercialization of its SBV technology. (Please select all that apply.) [MULTIPLE RESPONSE] [similar to SBIR33]

1. No funding to date other than SBV award
2. Funding prior to applying for SBV
3. Funding during the SBV research project (non-SBV funding - funding other than the SBV award)
4. Funding after the SBV research was completed

97. DK

98. Ref

Q22. [IF Q21 = 2, 3, OR 4 (RECEIVED FUNDING AT SOME TIME)] Have you received funding from… (Please select all that apply to indicated non-SBV funding your firm has received at any time for the development and/or commercialization of its SBV technology.) [MULTIPLE RESPONSE] [~SBIR34]

1. Parent company/organization
2. Angel or venture capital investor, incubator/accelerator
3. DOE (funding other than SBV award)
4. Other federal agency or agencies
5. State or local government or quasi-governmental agencies
6. Universities and/or not-for-profit organizations
7. Friends, other relationship-based funding
8. Private sector source not listed above
9. Personal funds

97. DK

98. Ref

Q23a. [IF Q21 = 3 OR 4 (RECEIVED FUNDING DURING OR AFTER)] How has your firm's SBV experience influenced, if at all, the source or amount of non-SBV funding you have received for the technology's development or commercialization?

1. Not at all
2. Only a little
3. Somewhat
4. A lot

97. DK

98. Ref

Q23b. [IF Q23a = 2 OR 3 OR 4 (RECEIVED FUNDING DURING OR AFTER)] Briefly describe how the amount of non-SBV funding you have received for the technology's development or commercialization was influenced by the SBV program?

[OPEN-ENDED]

Q24. [IF Q21 = 2 (RECEIVED FUNDING PRIOR)] Please check the response that best describes the amount of non-SBV funding your firm has received for the technology prior to your firm's SBV application from any source. (Please read down the columns.) [SINGLE RESPONSE] [~SBIR34]

< $100k								
$100k to < $250k	$1M to < $1.25M	$2M to < $2.25M	$3M to < $3.25M	$4M to < $4.25M	$5M to < $5.5M	$7M to < $7.5M	$9M to < $9.5M	$12M to < $13M
$250k to < $500k	$1.25M to < $1.5M	$2.25M to < $2.5M	$3.25M to < $3.5M	$4.25M to < $4.5M	$5.5M to < $6M	$7.5M to < $8M	$9.5M to < $10M	$13M to < $14M
$500k to < $750k	$1.5M to < $1.75M	$2.5M to < $2.75M	$3.5M to < $3.75M	$4.5M to < $4.75M	$6M to < $6.5M	$8M to < $8.5M	$10M to < $11M	$14M to < $15M
$750k to < $1M	$1.75M to < $2M	$2.75M to < $3M	$3.75M to < $4M	$4.75M to < $5M	$6.5M to < $7M	$8.5M to < $9M	$11M to < $12M	$15M & up
								Don't know

Q24b. [SKIP IF Q24 = DON'T KNOW]. Approximately what percent of this non-SBV funding was private funding? And what percent was government funding (non-SBV)? [NUMERIC RESPONSE OF 100 OR LESS]

Type of Funding	**Percent of funding**
Private funding	
Government funding (non-SBV	

Q25. [IF Q21 = 3 OR 4 (RECEIVED FUNDING DURING OR AFTER)] Please check the response that best describes the non-SBV funding your firm has received for the technology from any source since your firm received its SBV award. (Please read down the columns.) [SINGLE RESPONSE] [~SBIR34]

< $100k								
$100k to < $250k	$1M to < $1.25M	$2M to < $2.25M	$3M to < $3.25M	$4M to < $4.25M	$5M to < $5.5M	$7M to < $7.5M	$9M to < $9.5M	$12M to < $13M
$250k to < $500k	$1.25M to < $1.5M	$2.25M to < $2.5M	$3.25M to < $3.5M	$4.25M to < $4.5M	$5.5M to < $6M	$7.5M to < $8M	$9.5M to < $10M	$13M to < $14M
$500k to < $750k	$1.5M to < $1.75M	$2.5M to < $2.75M	$3.5M to < $3.75M	$4.5M to < $4.75M	$6M to < $6.5M	$8M to < $8.5M	$10M to < $11M	$14M to < $15M
$750k to < $1M	$1.75M to < $2M	$2.75M to < $3M	$3.75M to < $4M	$4.75M to < $5M	$6.5M to < $7M	$8.5M to < $9M	$11M to < $12M	$15M & up
								Don't know

Q25b. [SKIP IF Q25 = DON'T KNOW]. Approximately what percent of this non-SBV funding was private funding? And what percent was government funding (non-SBV)? [NUMERIC RESPONSE OF 100 OR LESS]

Type of Funding	**Percent of funding**
Private funding	
Government funding (non-SBV	

Q26. [ASK ALL] Which of the following best describes any licensing your firm has done of its SBV technology. [SINGLE RESPONSE] [~SBIR35]

1. No licensing
2. Licensed, no sales to date by licensing organization
3. Licensed, sales revenue obtained by licensing organization

97. DK
98. Ref

Q27. [IF Q26 = 4 (LICENSED AND SALES)] Please check the response that best describes the sales revenue obtained by the licensing organization. (Please read down the columns.) [SINGLE RESPONSE] [~SBIR36c]

< $100k								
$100k to < $250k	$1M to < $1.25M	$2M to < $2.25M	$3M to < $3.25M	$4M to < $4.25M	$5M to < $5.5M	$7M to < $7.5M	$9M to < $9.5M	$12M to < $13M
$250k to < $500k	$1.25M to < $1.5M	$2.25M to < $2.5M	$3.25M to < $3.5M	$4.25M to < $4.5M	$5.5M to < $6M	$7.5M to < $8M	$9.5M to < $10M	$13M to < $14M
$500k to < $750k	$1.5M to < $1.75M	$2.5M to < $2.75M	$3.5M to < $3.75M	$4.5M to < $4.75M	$6M to < $6.5M	$8M to < $8.5M	$10M to < $11M	$14M to < $15M
$750k to < $1M	$1.75M to < $2M	$2.75M to < $3M	$3.75M to < $4M	$4.75M to < $5M	$6.5M to < $7M	$8.5M to < $9M	$11M to < $12M	$15M & up
								Don't know

Q28. [ASK ALL] Please estimate the number of people currently employed at your firm. Please provide a single numeric response; [CONSTRAIN RESPONSES TO NUMERIC] [~SBIR 18b]

Q29. [ASK ALL] Had your firm *not* undertaken the SBV project, about how many people do you estimate would currently be employed at your firm? Please provide a single numeric response; [CONSTRAIN RESPONSES TO NUMERIC]

B.1.4 Future Engagement

Q35. Please rate the likelihood that you will work with the DOE National Laboratories 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 DOE National Laboratories?

1 Yes, I have recommended my colleagues work with the DOE National Laboratories
2 Yes, I likely will recommend my colleagues work with the DOE National Laboratories
3 No
97 Don't Know

That's all of our questions. THANK YOU!

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

Thank you for taking the time to provide feedback on your experience with applying to the Small Business Voucher, or SBV, pilot program. Your feedback contributes to the evaluation of the U.S. Department of Energy's (DOE) SBV Pilot.

We appreciate your willingness to complete this survey. You can stop at any time. The survey should take less than 15 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. Are you knowledgeable of your firm's application to the Small Business Voucher (SBV) pilot in the spring and summer of 2016.

1 Yes,

2 No

97 Don't Know

98 Refused

SC1a. [IF SC1 = 97 (DK] Please provide the name and email address of the person at your firm who is most knowledgeable of the application to the SBV pilot.

[Open-ended response & exit questionnaire]

SC2. What was your role with the firm at the time it applied to the Small Business Voucher (SBV) pilot? Please select all that apply. [MULTIPLE RESPONSE]. [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 (Go to SC2a)

SC2a. [IF SC2 = 5 (None of the above] Please provide the name and email address of the person at your firm who is most knowledgeable of the application to the SBV pilot.

[Open-ended response & exit questionnaire]

B.2.3 SBV Technology

Q1. The following questions address the technology for which your firm applied to the SBV pilot. We call this your "SBV-related technology." Has your firm completed its research on the SBV-related technology? (Please select best response.) [~SBIR30]

1. Yes, research project completed
2. No, research project still underway
3. No, research terminated prior to completion

97. Don't know
98 Refused

Q2. Is your firm continuing its involvement with its SBV-related technology? [SINGLE RESPONSE]

1. Yes, firm's involvement continues
2. No, firm has discontinued its efforts related to this technology

97. Don't know
98 Refused

Q3 [IF Q2 = 2, DISCONTINUED] Which of the following were reasons your firm has discontinued its efforts related to this technology? Please check all that apply. [MULTIPLE RESPONSE] [~SBIR Q31]

1. Technical failure or difficulties
2. Market demand too small
3. Level of technical risk too high
4. Not enough funding
5. Company shifted priorities
6. Principal investigator left
7. Project goal was achieved (for example, a prototype was delivered)
8. Licensed to another company
9. Product, process, or service not competitive
10. Inadequate sales capability
11. Another firm got to the market before us
12. Other (please specify):

97. Don't recall/ don't know
98 Refused

Q4. [IF Q2 = 2, DISCONTINUED] Which of these was the primary reason for discontinuing efforts relating to this technology? [pipe in reasons marked "yes" in Q2 for respondents to choose from) [SINGLE RESPONSE] [~SBIR Q32]

Q5. [IF Q2 = 2, DISCONTINUED] Briefly, how did your firm's SBV application experience influence, if at all, your decision to discontinue efforts related to this technology? (If no influence, please write None)

[OPEN ENDED]

Q6 [IF Q1=1, RESEARCH COMPLETED] Please check the quarter in which your firm completed its research on the SBV-related technology. [RADIO BUTTONS IN EACH CELL. SINGLE RESPONSE]

Year/Quarter	Q1 (Jan-Mar)	Q2 (Apr-Jun)	Q3 (Jul-Sep)	Q4 (Oct-Dec)
2016				
2017				
2018				
2019				

Q7. [ASK ALL] Which of the following describe any use of your firm's SBV-related technology, both before you applied to the SBV pilot and after you applied. (Please select all that apply.) [RADIO BUTTONS IN EACH CELL. MULTIPLE RESPONSE IN EACH COLUMN] [overlap with some of SBIR 30]

Use of your firm's SBV-related technology	Before applying to SBV	After applying to SBV

1. No market use to date		
2. Use by anticipated target market		
3. Use by unanticipated market sectors/segments		
4. Use by consumers (individuals, households)		
5. Use by businesses in the creation of their products (as an input, or part of a process)		
6. Use by businesses in the delivery of their services		
7. Use by businesses in a capacity other than above		
8. Use by government		
9. Other (Please specify:_____)		
97. DK		
98. Ref		

Q7a. Briefly, please describe the target market for your SBV technology, before you applied to the SBV pilot. [OPEN-ENDED]

Q7b. Have you somewhat or fully pivoted from that target market to a new target market? [SINGLE RESPONSE]

Yes, somewhat pivoted to a new target market
Yes, fully pivoted to a new target market
No
DK
Refused

Q7c. [IF YES TO Q7b] Briefly, please describe the new target market for your SBV-related technology. [OPEN-ENDED]

Q7d. . [IF YES TO Q7b] Briefly, how has your firm's SBV application experience influenced, if at all, the markets you target for your SBV technology?

[OPEN-ENDED]

Q8. [ASK ALL] Please indicate the stage of development/commercialization that best describes your innovation today and at the time you applied to the SBV pilot. [CONSTRAIN TO A SINGLE RESPONSE IN EACH COLUMN]

Stage of development / commercialization	Today	At time of applying to SBV
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/ sales beyond early adopters		

Q8a. [ASK IF Q8 STAGE OF DEVELOPMENT TODAY < AT TIME OF SBV AWARD] Why is your innovation at an earlier stage of development/commercialization now compared to at the time you applied for an SBV award? [ADD TEXT BOX FOR RESPONSE]

Q9. [SKIP IF Q2 = 2, DISCONTINUED] Has your firm begun to commercialize (made any product/process/service sales of) its SBV-related technology? [SINGLE RESPONSE]

Yes
No
97. DK
98. Ref

Q10. [IF Q9 = 1 (YES COMMERCIALIZE)] Please briefly describe your firm's commercialization activities, outcomes, and how your SBV application experience contributed to that, if at all. [ADD TEXT BOX FOR RESPONSE]

Q11] Please indicate the extent to which the SBV application experience contributed to the commercialization of your SBV technology.

1. Not at all
2. Only a little
3. Somewhat
4. A lot

97. DK

98. Ref

Q12. [SKIP IF Q2 = 2, DISCONTINUED] Please give the number of patents, copyrights, trademarks and/or scientific publications for the SBV-related technology developed since applying to the SBV pilot. Enter numerals. If none, enter 0 (zero). [SBIR39]

	Number Applied For/Submitted	Number Received/ Published
Patents		
Copyrights		

Trademarks		
Scientific/ Technical Publications		

Q13. [ASK IF ANY NON-ZERO VALUES ENTERED IN Q12] Please rate the extent to which the SBV application experience contributed to these patents, copyrights, trademarks, or publications.

1. Not at all
2. Only a little
3. Somewhat
4. A lot

97. DK

98. Ref

Q14. [ASK ALL] Which if any of the following has the firm experienced since applying to the SBV pilot? [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				

Q15. [ASK IF ANY YES VALUES ENTERED IN Q26] Please rate the extent to which your firm's SBV application experience contributed to these corporate developments.

1. Not at all
2. Only a little
3. Somewhat
4. A lot

97. DK

98. Ref

Q16. [ASK ALL] Which of the following describe any sales revenue (exclusive of licensing fees) your firm has received from its SBV-related technology? (Please select all that apply.) [MULTIPLE RESPONSE] [similar to SBIR35]

1. No sales revenue to date
2. Sales revenue prior to applying to the SBV pilot
3. Sales revenue after applying to the SBV pilot but before completing research on the technology
4. Sales revenue after completing research on the SBV-related technology

97. DK

98. Ref

Q17 [IF Q7 = 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 (USE) AND Q16 = 1 (NO REVENUE)] Briefly, please explain why you reported in a previous response the SBV-related technology is in use in the market and report no sales revenues to date.

[OPEN ENDED]

Q18. [IF Q16 = 2 OR 3 OR 4 (SALES REVENUE PRIOR, DURING, OR AFTER)] Briefly, how has your firm's SBV application experience influenced, if at all, who is using the technology or the amount of revenues you have received?

[OPEN-ENDED]

Q19. [IF Q16=2, SALES PRIOR TO SBV] Please check the response that best describes the technology's sales revenues (exclusive of licensing fees) prior to your firm's SBV application? (Please read down the columns.) [SINGLE RESPONSE]

< $100k								
$100k to < $250k	$1M to < $1.25M	$2M to < $2.25M	$3M to < $3.25M	$4M to < $4.25M	$5M to < $5.25M	$7M to < $7.5M	$9M to < $9.5M	$12M to < $13M
$250k to < $500k	$1.25M to < $1.5M	$2.25M to < $2.5M	$3.25M to < $3.5M	$4.25M to < $4.5M	$5.5M to < $6M	$7.5M to < $8M	$9.5M to < $10M	$13M to < $14M
$500k to < $750k	$1.5M to < $1.75M	$2.5M to < $2.75M	$3.5M to < $3.75M	$4.5M to < $4.75M	$6M to < $6.5M	$8M to < $8.5M	$10M to < $11M	$14M to < $15M
$750k to < $1M	$1.75M to < $2M	$2.75M to < $3M	$3.75M to < $4M	$4.75M to < $5M	$6.5M to < $7M	$8.5M to < $9M	$11M to < $12M	$15M & up
								Don't know

Q20. [IF Q16=3 OR 4, SALES DURING OR AFTER SBV] Please check the response that best describes the total technology's sales revenues (exclusive of licensing fees) since your firm applied to the SBV program? (Please read down the columns.) [SINGLE RESPONSE] [~SBIR36b]

< $100k								
$100k to < $250k	$1M to < $1.25M	$2M to < $2.25M	$3M to < $3.25M	$4M to < $4.25M	$5M to < $5.25M	$7M to < $7.5M	$9M to < $9.5M	$12M to < $13M
$250k to < $500k	$1.25M to < $1.5M	$2.25M to < $2.5M	$3.25M to < $3.5M	$4.25M to < $4.5M	$5.5M to < $6M	$7.5M to < $8M	$9.5M to < $10M	$13M to < $14M
$500k to < $750k	$1.5M to < $1.75M	$2.5M to < $2.75M	$3.5M to < $3.75M	$4.5M to < $4.75M	$6M to < $6.5M	$8M to < $8.5M	$10M to < $11M	$14M to < $15M
$750k to < $1M	$1.75M to < $2M	$2.75M to < $3M	$3.75M to < $4M	$4.75M to < $5M	$6.5M to < $7M	$8.5M to < $9M	$11M to < $12M	$15M & up
								Don't know

Q21. [ASK ALL] Which of the following describe any funding your firm has received for the development and/or commercialization of its SBV-related technology. (Please select all that apply.) [MULTIPLE RESPONSE] [~SBIR33]

1. No funding to date
2. Funding prior to applying to the SBV pilot
3. Funding after applying to the SBV pilot and while conducting research on the SBV-related technology
4. Funding after completing research on the SBV-related technology

97. DK
98. Ref

Q22. [IF Q21 = 2, 3, OR 4 (RECIVED FUNDING AT SOME TIME)] Have you received funding from… (Please select all that apply to indicated non-SBV funding your firm has received at any time for the development and/or commercialization of its SBV-related technology.) [MULTIPLE RESPONSE] [~SBIR34]

1. Parent company/organization
2. Angel or venture capital investor, incubator/accelerator;
3. DOE
4. Other federal agency or agencies
5. State or local government or quasi-governmental agencies
6. Universities and/or not-for-profit organizations
7. Friends, other relationship-based funding
8. Private sector source not listed above

97. DK

98. Ref

Q23. [IF Q21 = 3 OR 4 (RECEIVED FUNDING DURING OR AFTER)] Briefly, how has your firm's SBV application experience influenced, if at all, the source or amount of funding you have received for the technology's development or commercialization?

[OPEN-ENDED]

Q23b. [IF Q23a = 2 OR 3 OR 4 (RECEIVED FUNDING DURING OR AFTER)] Briefly describe how the amount of non-SBV funding you have received for the technology's development or commercialization was influenced by the SBV program?

[OPEN-ENDED]

Q24. [IF Q21 = 2 (RECIVED FUNDING PRIOR)] Please check the response that best describes the amount of non-SBV funding your firm has received for the technology prior to your firm's SBV application from any source. (Please read down the columns.) [SINGLE RESPONSE] [~SBIR34]

< $100k								
$100k to < $250k	$1M to < $1.25M	$2M to < $2.25M	$3M to < $3.25M	$4M to < $4.25M	$5M to < $5.5M	$7M to < $7.5M	$9M to < $9.5M	$12M to < $13M
$250k to < $500k	$1.25M to < $1.5M	$2.25M to < $2.5M	$3.25M to < $3.5M	$4.25M to < $4.5M	$5.5M to < $6M	$7.5M to < $8M	$9.5M to < $10M	$13M to < $14M
$500k to < $750k	$1.5M to < $1.75M	$2.5M to < $2.75M	$3.5M to < $3.75M	$4.5M to < $4.75M	$6M to < $6.5M	$8M to < $8.5M	$10M to < $11M	$14M to < $15M
$750k to < $1M	$1.75M to < $2M	$2.75M to < $3M	$3.75M to < $4M	$4.75M to < $5M	$6.5M to < $7M	$8.5M to < $9M	$11M to < $12M	$15M & up
								Don't know

Q25b. [SKIP IF Q24 = DON'T KNOW]. Approximately what percent of this funding was private funding? And what percent was government funding? [NUMERIC RESPONSE OF 100 OR LESS]

Type of Funding	Percent of funding
Private funding	
Government funding	

Q25. [IF Q21 = 3 OR 4 (RECIVED FUNDING DURING OR AFTER)] Please check the response that best describes the non-SBV funding your firm has received for the technology from any source since your firm applied to the SBV pilot. (Please read down the columns.) [SINGLE RESPONSE] [~SBIR34]

< $100k								
$100k to < $250k	$1M to < $1.25M	$2M to < $2.25M	$3M to < $3.25M	$4M to < $4.25M	$5M to < $5.5M	$7M to < $7.5M	$9M to < $9.5M	$12M to < $13M
$250k to < $500k	$1.25M to < $1.5M	$2.25M to < $2.5M	$3.25M to < $3.5M	$4.25M to < $4.5M	$5.5M to < $6M	$7.5M to < $8M	$9.5M to < $10M	$13M to < $14M
$500k to < $750k	$1.5M to < $1.75M	$2.5M to < $2.75M	$3.5M to < $3.75M	$4.5M to < $4.75M	$6M to < $6.5M	$8M to < $8.5M	$10M to < $11M	$14M to < $15M
$750k to < $1M	$1.75M to < $2M	$2.75M to < $3M	$3.75M to < $4M	$4.75M to < $5M	$6.5M to < $7M	$8.5M to < $9M	$11M to < $12M	$15M & up
								Don't know

Q25b. [SKIP IF Q25 = DON'T KNOW]. Approximately what percent of this funding was private funding? And what percent was government funding? [NUMERIC RESPONSE OF 100 OR LESS]

Type of Funding	Percent of funding
Private funding	
Government funding	

Q26. [ASK ALL] Which of the following best describes any licensing your firm has done of its SBV-related technology. SINGLE RESPONSE] [~SBIR35]

1. No licensing
2. Licensed, no sales to date by licensing organization
3. Licensed, sales revenue obtained by licensing organization

97. DK

98. Ref

Q27. [IF Q26 = 4 (LICENSED AND SALES)] Please check the response that best describes the sales revenue obtained by the licensing organization. (Please read down the columns.) [SINGLE RESPONSE] [~SBIR36c]

< $100k								
$100k to < $250k	$1M to < $1.25M	$2M to < $2.25M	$3M to < $3.25M	$4M to < $4.25M	$5M to < $5.5M	$7M to < $7.5M	$9M to < $9.5M	$12M to < $13M
$250k to < $500k	$1.25M to < $1.5M	$2.25M to < $2.5M	$3.25M to < $3.5M	$4.25M to < $4.5M	$5.5M to < $6M	$7.5M to < $8M	$9.5M to < $10M	$13M to < $14M
$500k to < $750k	$1.5M to < $1.75M	$2.5M to < $2.75M	$3.5M to < $3.75M	$4.5M to < $4.75M	$6M to < $6.5M	$8M to < $8.5M	$10M to < $11M	$14M to < $15M
$750k to < $1M	$1.75M to < $2M	$2.75M to < $3M	$3.75M to < $4M	$4.75M to < $5M	$6.5M to < $7M	$8.5M to < $9M	$11M to < $12M	$15M & up
								Don't know

Q28. [ASK ALL] Please estimate the number of people currently employed at your firm. Please provide a single numeric response; provide the mid-point of any range. [CONSTRAIN RESPONSES TO NUMERIC] [~SBIR 18b]

Q29. [ASK ALL] Had your firm *not* applied to the SBV pilot, about how many people do you estimate would currently be employed at your firm? Please provide a single numeric response; provide the mid-point of any range. [CONSTRAIN RESPONSES TO NUMERIC]

B.2.4 Future Engagement

Q30. Are you currently working with a DOE National Laboratory or considering working with a DOE National Laboratory in the future?

1. Yes
2. No
3. 97. DK
4. 98. Ref

Q35. [ASK IF Q30 = YES] Please rate the likelihood that you will work with a DOE National Laboratory again. [1= NOT AT ALL LIKELY, 5= VERY LIKELY; 97 = DON'T KNOW]

Q36. [ASK IF Q30 = YES] Have you, or will you, recommend to your colleagues in other small businesses that they work with a DOE National Laboratory?

1 Yes, I have recommended my colleagues work with a DOE National Laboratory
2 Yes, I likely will recommend my colleagues work with a DOE National Laboratory
3 No
97 Don't Know

That's all of our questions. THANK YOU!

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 [1]

Firm Characteristics	All SBV Awardees (n = 39*)	Round 1 Participants (n = 17)	Round 2 Participants (n = 17)	Round 3 Participants (n = 5*, 6**)	Non-participants (n = 18)
Age of Firm					
Min	0	1	1	0	0
Max	24	24	18	8	40
Mean	7.5	9.2	7.1	3	10.4
Median	5	7	4	2	6.5
Full Time Employees (FTEs)					
Min	0	0	2	0	0
Max	42	30	42	15	300
Mean	9.5	8.4	12.6	4.4	22.3
Median	4	4	9	2	3.5
Technology Readiness Level (TRL)					
Min	0	0	2.6	2.6	0
Max	9	9	9	9	9
Mean	6.1	5.8	6.6	5.5	5.6
Median	7.1	4.7	7.1	4.7	7.1

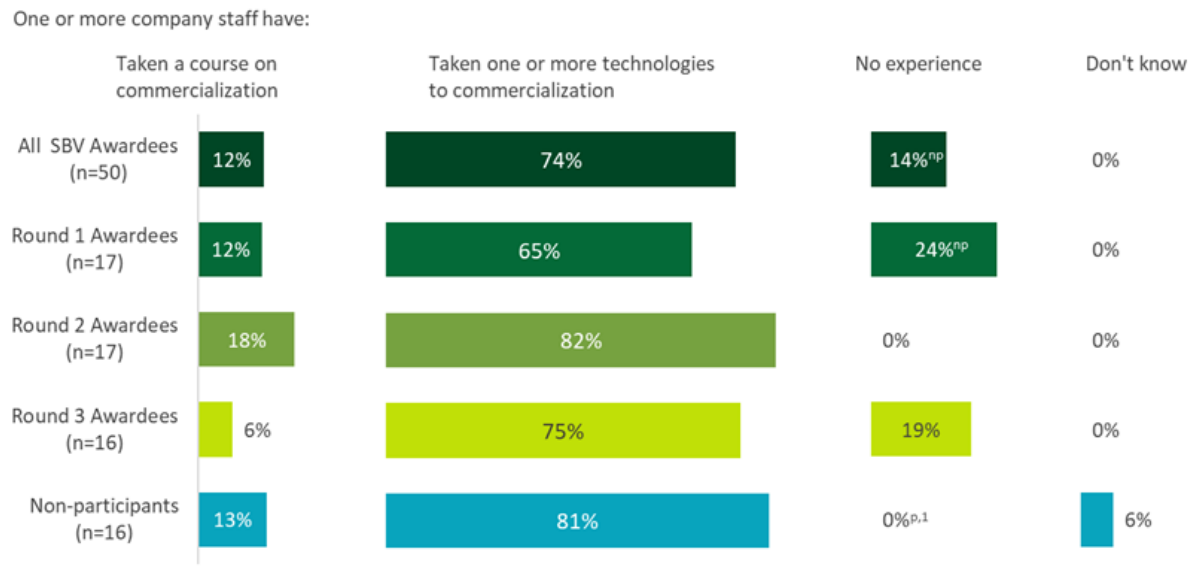
* Firm age data was only available for five of the 16 Round 3 awardees.
** FTE and TRL application data was only available for six of the 16 Round 3 awardees.
[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

Table 25: Technology Type [1]

	All SBV Awardees (n = 50)	Round 1 Participants (n = 17)	Round 2 Participants (n = 17)	Round 3 Participants (n = 16)	Non-participants (n = 18)
Software	36%	29%	35%	44%	39%
Hardware	64%	71%	65%	56%	61%

[1] All rounds of participants are not statistically significantly different from non-participants at the 90% confidence level.

Figure 25: Firms Previous Experience with Commercialization (multiple responses permitted)



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

Table 26: Technology Status Questions from SBV Application

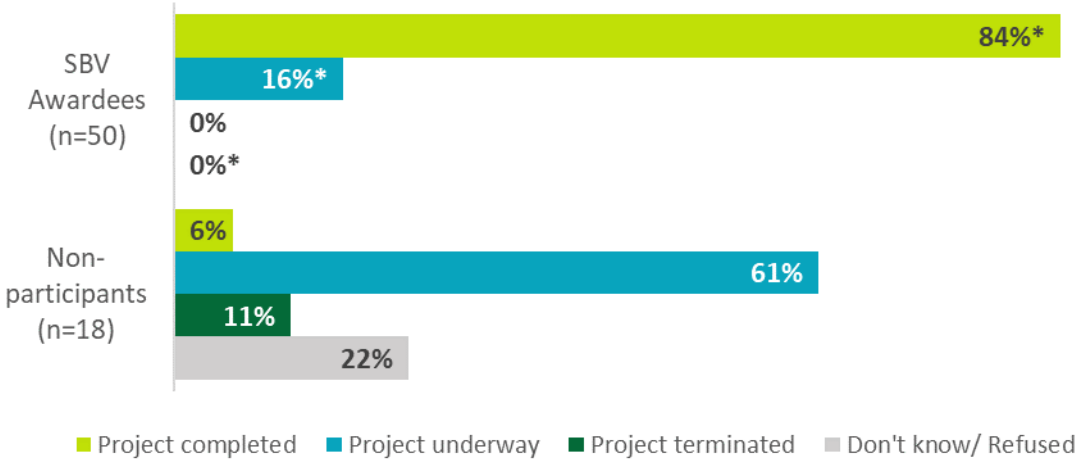
SBV Application Question	% Yes, All Awardees (n = 40*)	% Yes, Round 1 (n = 17)	% Yes, Round 2 (n = 17)	% Yes, Round 3 (n = 6*)	% Yes, Non-participants (n = 18)
Have you demonstrated the feasibility of the technology in the lab?	98%	94%	100%np	100%np	83%2,3
Have you created and tested (or are in the process of testing) a prototype?	83%	88%	76%	83%	72%
Have you demonstrated/Are you currently demonstrating the product/service in an initial pilot project or demonstration?	53%	41%	71%	33%	61%
Have you achieved sales – more than one – and are actively seeking more sales?	30%	29%	35%	17%	22%

* Technology status application data was only available for six of the 16 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.
3 Statistically significantly different from Round 3 awardees at the 90% confidence level.

C.2 SBV TECHNOLOGY STATUS

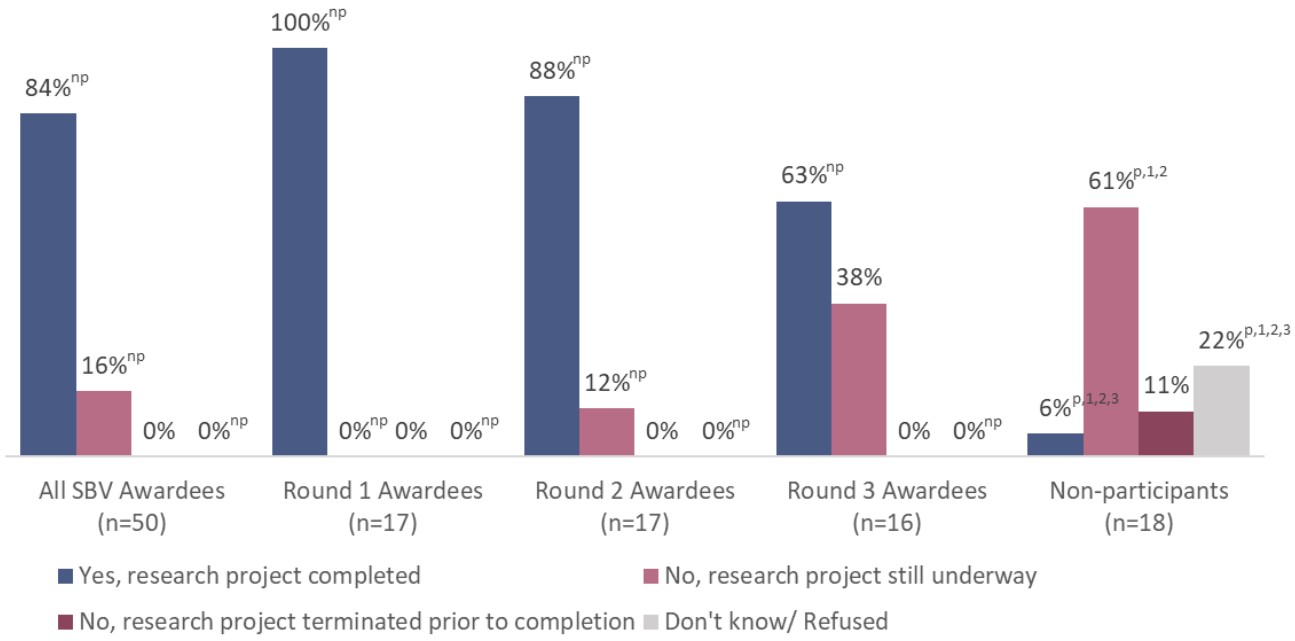
More than four in five awardees (84%) reported that their research project is complete, compared to 6% of non-participants (a statistically significant difference). The rest of the SBV awardees reported that their research project is still underway (16%). Eleven percent of non-participants reported that their research project was terminated prior to completion. We think this is a case of the two response groups interpreting the question very differently, as awardees and non-participants reported similar levels of continued involvement with their technology in the next question (see Figure 26). Whereas, it appears that awardees interpreted this question in terms of their SBV-specific research project, it appears that a high proportion of non-participants interpreted the question in terms of ongoing involvement with their technology.

Figure 26: SBV Research Project Completion Status



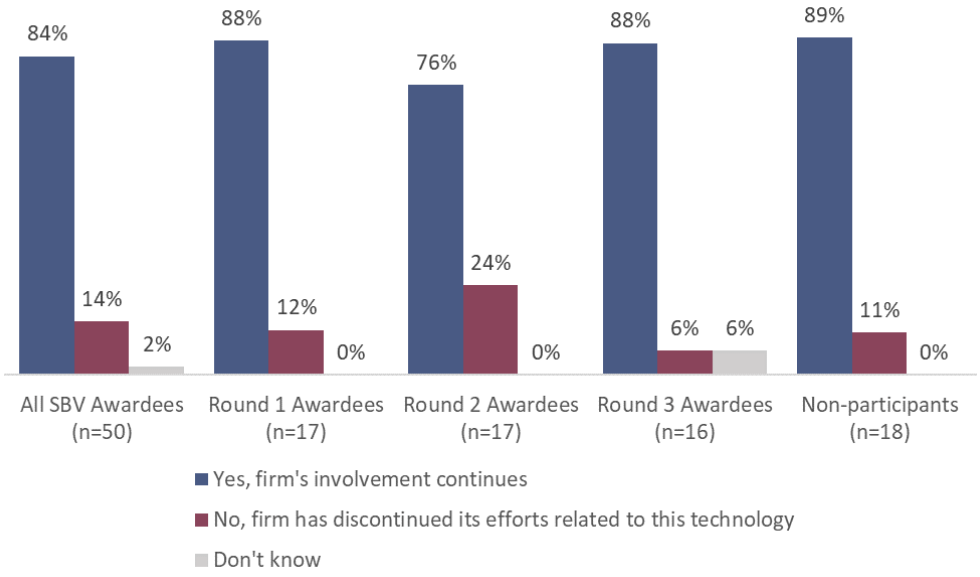
* Statistically significantly different at the 90% confidence level.

Figure 27: SBV Research Project Completion Status, by Round



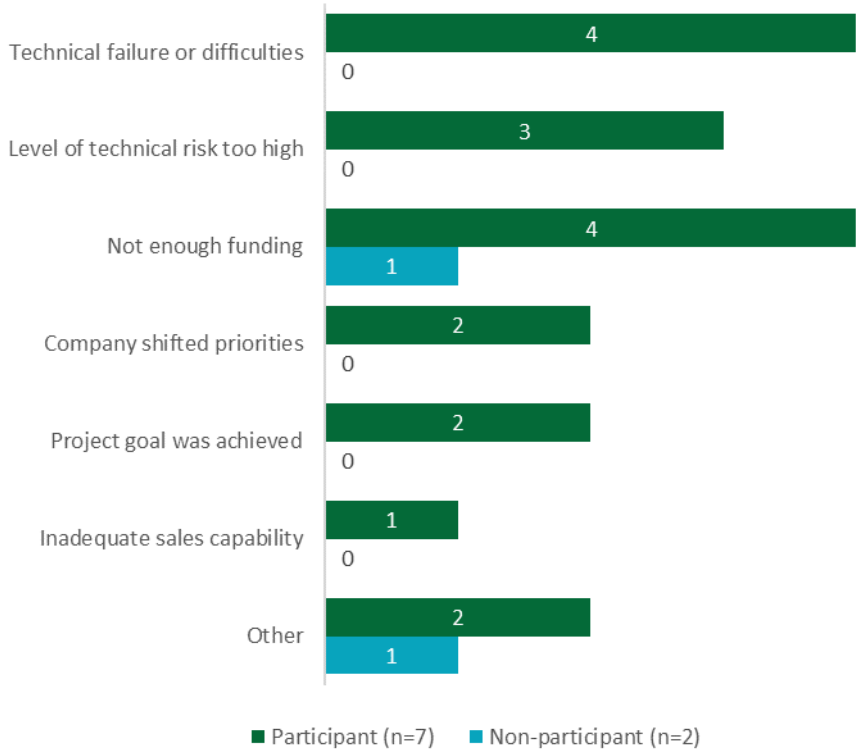
np Statistically significantly different from non-participants at the 90% confidence level.
p Statistically significantly different from All SPV participants at the 90% confidence level.
1 Statistically significantly different from Round 1 awardees at the 90% confidence level.
2 Statistically significantly different from Round 2 awardees at the 90% confidence level.
3 Statistically significantly different from Round 3 awardees at the 90% confidence level.

Figure 28: Continuation of Firm Involvement with SBV Technology [1]



1 All rounds of participants are not statistically significantly different from non-participants at the 90% confidence level.

Figure 29: Reasons for Discontinuation of Technology Efforts (multiple responses permitted) [1]



[1] Not tested for statistical difference due to small samples sizes.

Table 27: SBV Experience Influence on the Decision to Discontinue Technology Efforts [1]

SBV Application Question	All SBV Awardees (n = 5)	Non-participant (n =2)
Changed, ended project focus	3	0
Lack of funding/economic feasibility	1	1
CFD Analysis did not allow for additional testing	1	0
Nat Lab did not complete the work	0	1

[1] Not tested for statistical difference due to small samples sizes.

C.3 COMMERCIALIZATION ASSISTANCE

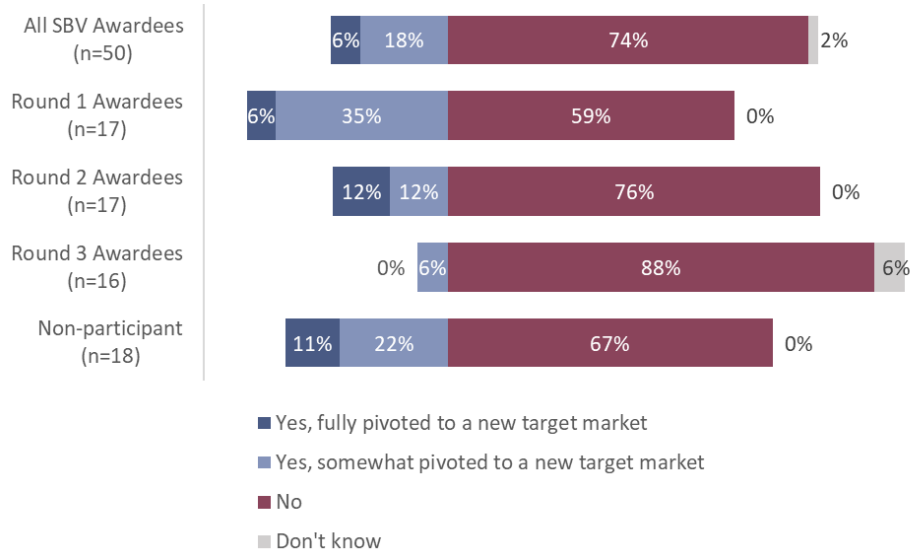
C.3.1 Target Markets, Commercialization Activities, and Market Use

Table 28: Target Market for SBV Technology Before Award SBV Award

Target Market	All SBV Participants (n=49)	Non-participants (n=18)
Renewables	18%	22%
Fuel cells	12%	0%
Electricity	6%	17%

Batteries and storage	4%	11%
Automobile	6%	6%
C&I	6%	6%
Biofuels	4%	6%
HVAC	4%	0%
Metals	4%	0%
Military	4%	0%
Polymers	4%	0%
Building envelope/windows	2%	6%
Electronic end uses	2%	6%
Hydropower	2%	6%
Manufacturing	2%	6%
Water treatment	2%	0%
Natural gas	0%	6%
Other	16%	6%

Figure 30: SBV Technology Pivot to New Target Market [1]



[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

Table 29: New Target Market for SBV Technology

New Target Market	All SBV Participants (n=11)	Non-participants (n=6)
Electricity	1	2
Manufacturing	3	0
Automobile	1	1
Biofuels	0	1
Buildings	1	0
C&I	1	0
Fuel cells	1	0
Other	2	2

Figure 31: SBV Experience Influence on Target Markets

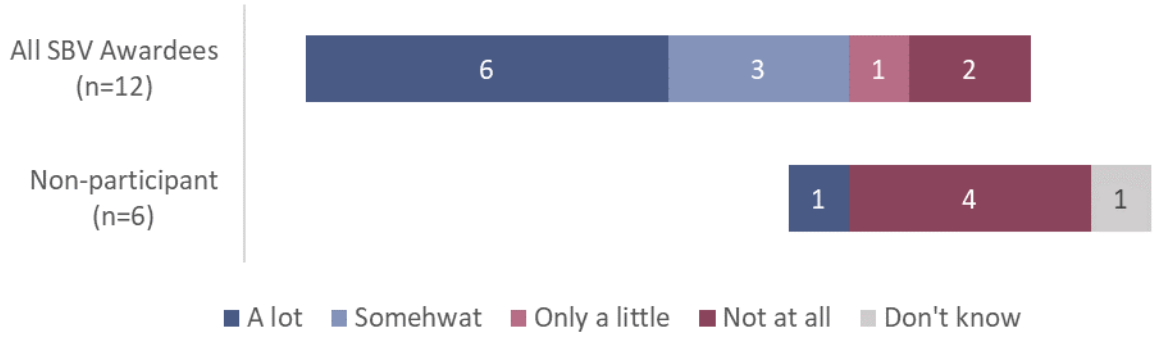
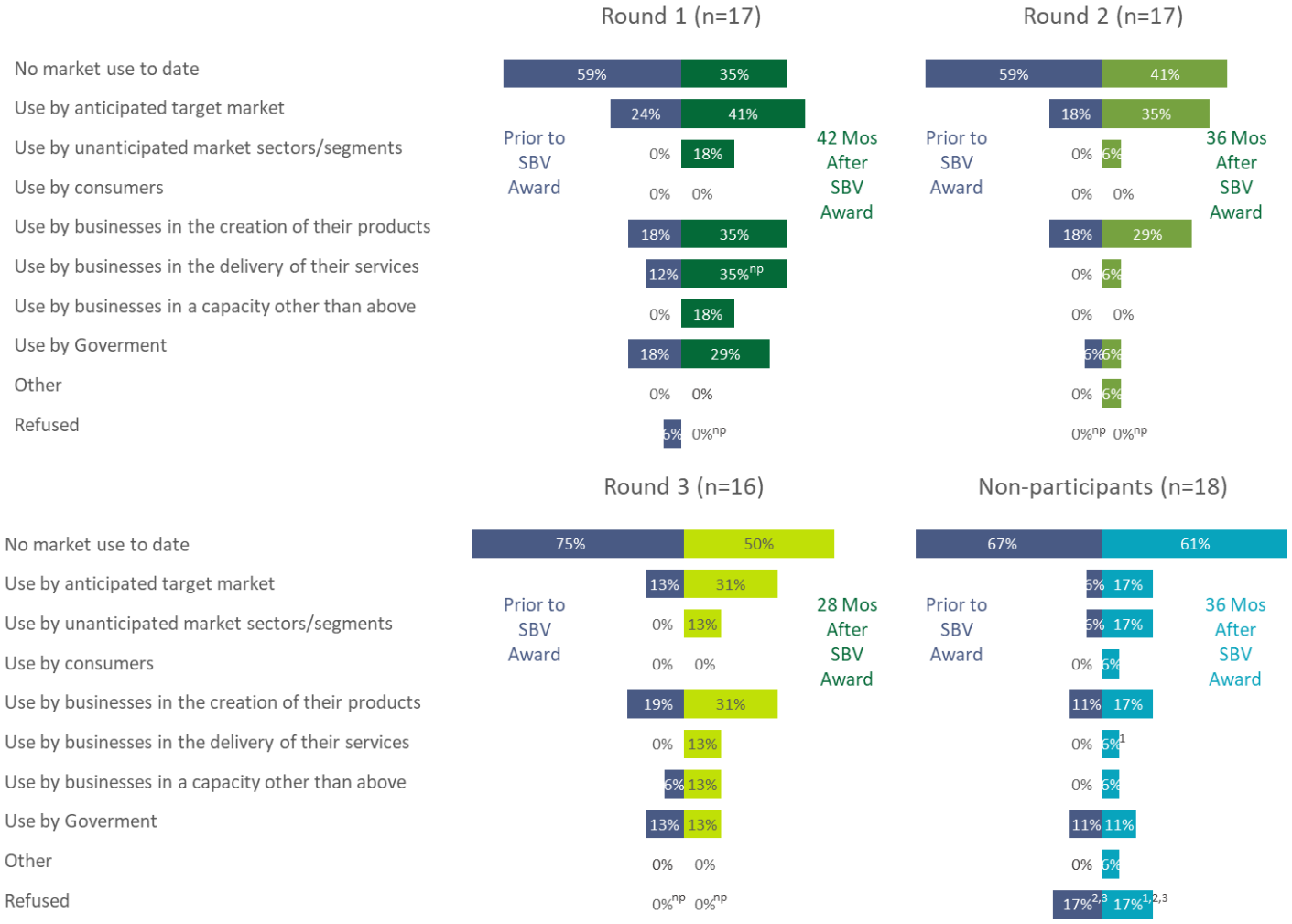
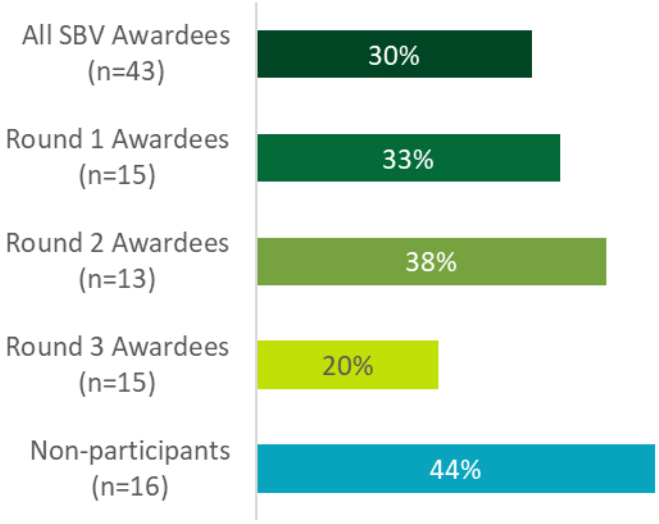


Figure 32: SBV Technology Use (multiple responses permitted)



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 33: Commercialization of SBV Technology [1]



[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

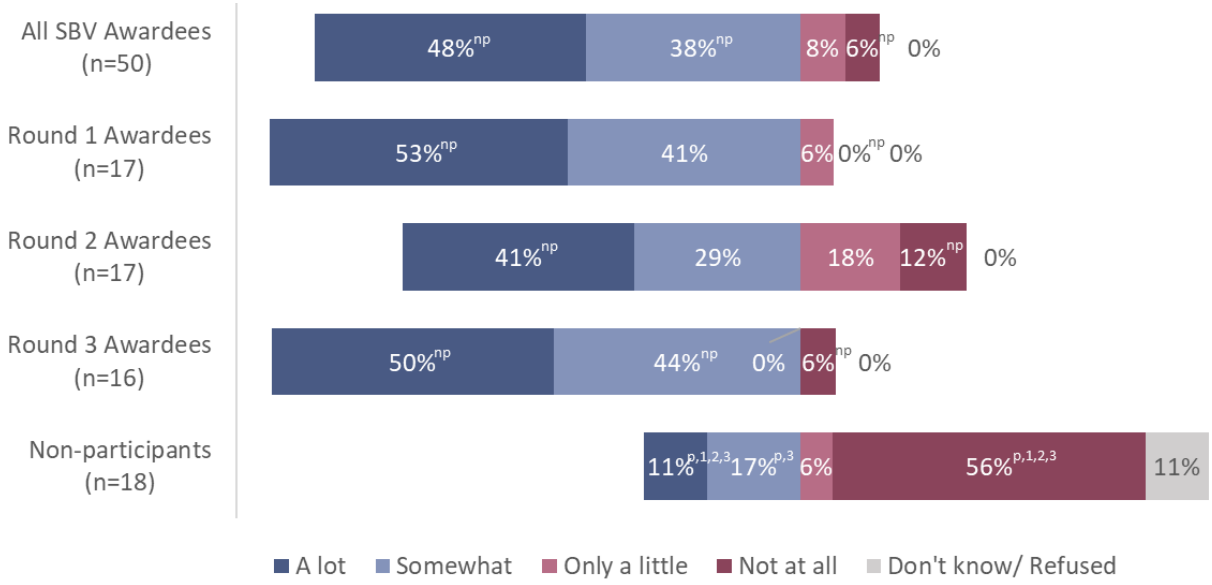
Table 30: Commercialization and Activities

Commercialization Activities and Outcomes	All SBV Participants (n=11)	Non-participants (n=5)
Advancements in performance, technology and modeling	2	2
Adoption, production, and sales/ application of technology	4	0
Licensing technology	1	1
Active in sales	1	1
Expanded company	1	0
Expanded portfolio	1	0
Piloting demonstrations of technology	1	0
International partnerships	0	1

Table 31: SBV Contribution to Commercialization and Activities

SBV Contribution	All SBV Participants (n=11)	Non-participants (n=5)
Improved understanding of production yield and reduction in costs	3	0
Access to analytical information and R&D technology	3	0
Get product to market	3	0
Refined focus	1	0
Improve downstream processing/ product piloting	1	0
Establish early adopters and production demand	0	1
None	0	4

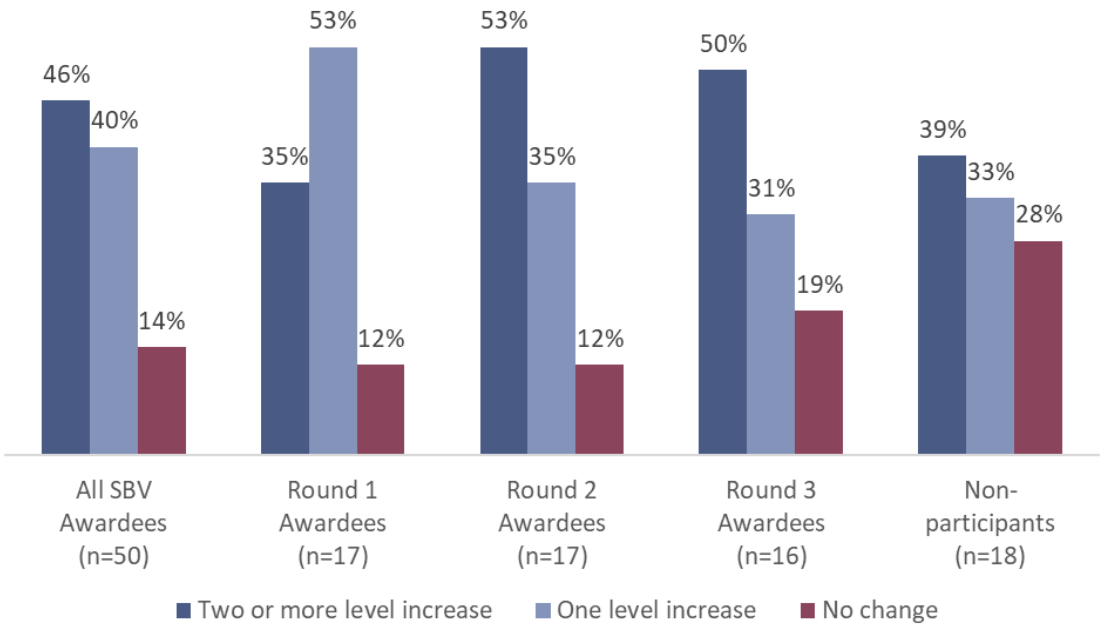
Figure 34: SBV Experience's Contribution to Commercialization of SBV Technology



np Statistically significantly different from non-participants at the 90% confidence level.
p Statistically significantly different from All SBV 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.

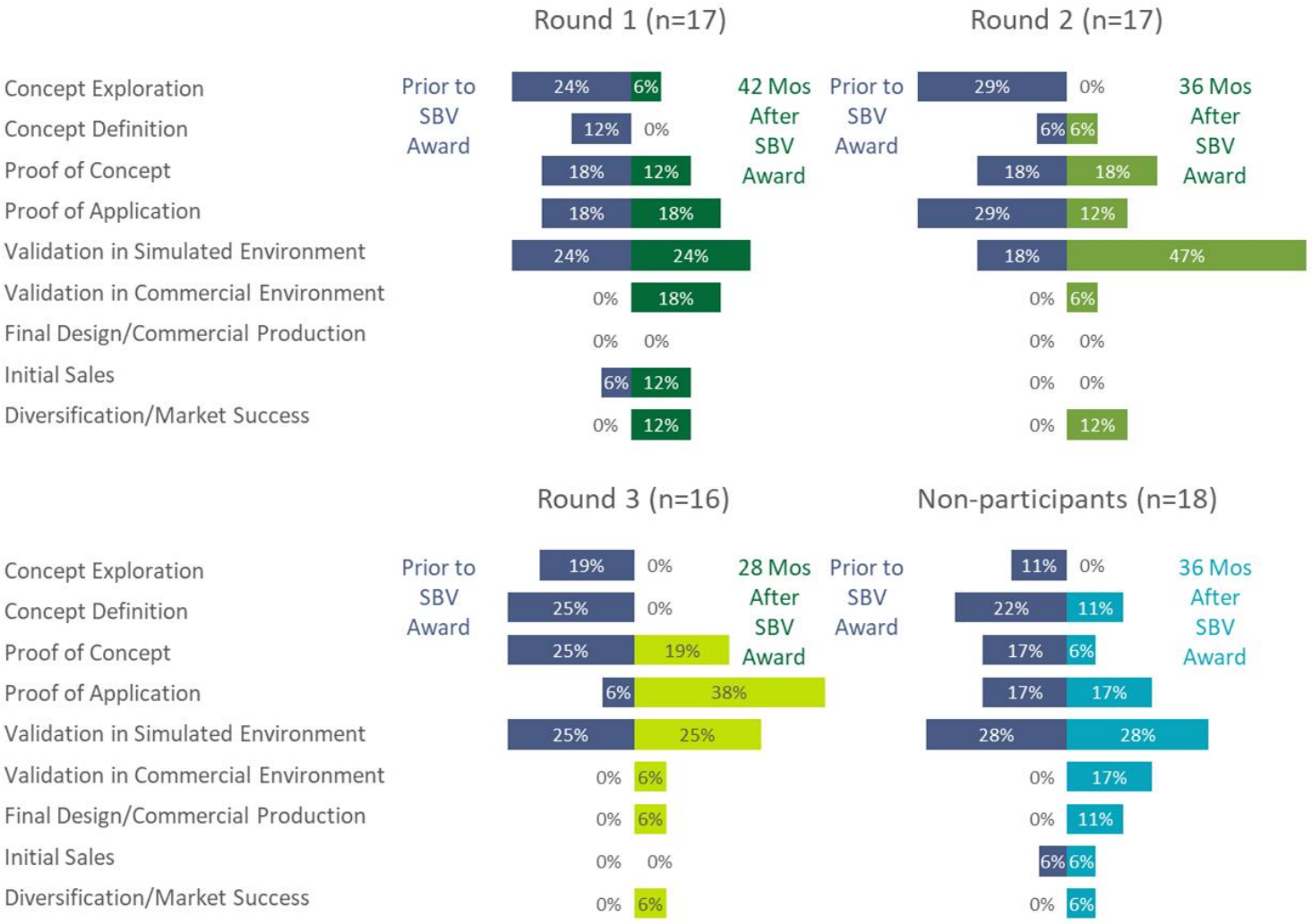
C.3.2 Advancement of Technology Readiness Levels

Figure 35: Change in Stage of Development/Commercialization [1]



[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

Figure 36: Awardee Stage of Development Before and After SBV Award



[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

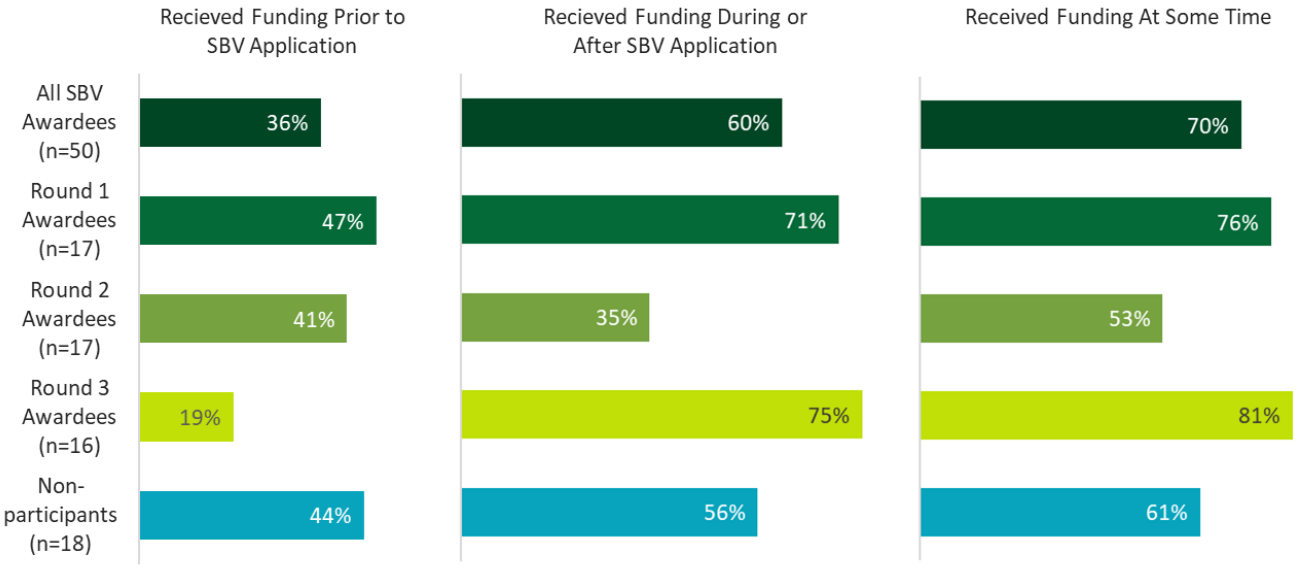
Table 32: Awardee Stage of Development Before and After SBV Award [1]

Stage of Development/ Commercialization	R1 (n=17)		R2 (n=17)		R3 (n=16)		Non-participants (n=18)	
	Time of SBV Award	Post Award	Time of SBV Award	Post Award	Time of SBV Award	Post Award	Time of SBV Award	Post Award
Conceptualization and proof of concept (1 to 4)	71%	35%	82%	35%	75%	56%	67%	33%
Validation stages (5 & 6)	23%	41%	18%	53%	25%	31%	28%	45%
Commercialization stages (7 to 9)	6%	24%	0%	12%	0%	13%	5%	22%
Average	3.4	5.4	3	4.9	2.9	4.7	3.6	5.2

[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

C.3.3 Follow-on Funding and Sales

Figure 37: Percent of Respondents that Received or Invested Additional Development Funding (multiple responses permitted) [1]



[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

Table 33: Distribution of Total Additional Funding by Source (multiple responses permitted)

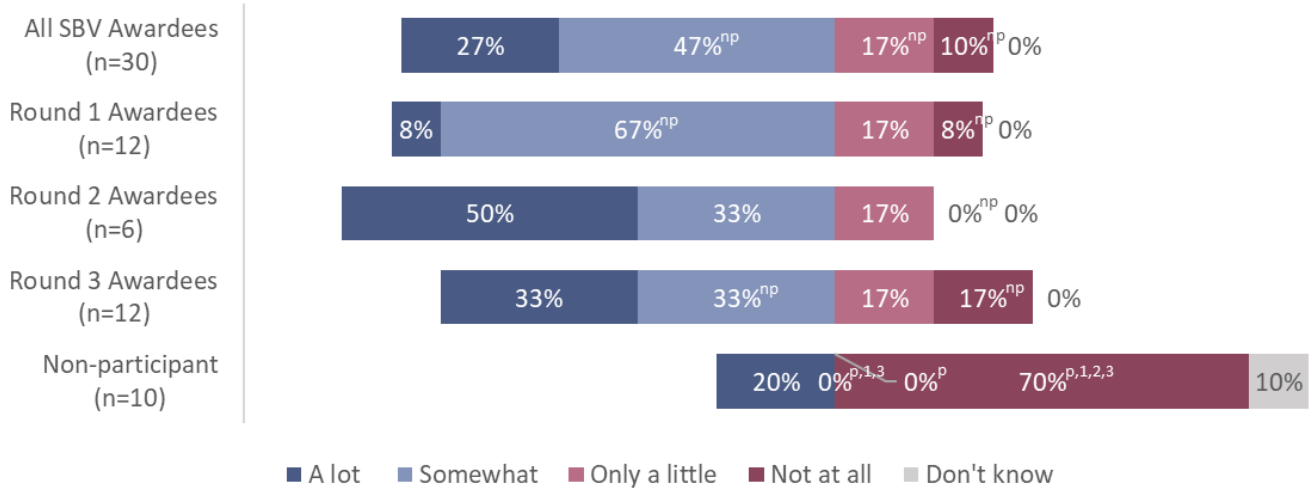
	All SBV Awardees (n = 35)	Round 1 Awardees (n = 13)	Round 2 Awardees (n = 9)	Round 3 Awardees (n = 13)	Non-participants (n = 11)
Parent company/organization	14%	23%	22%	0%	9%
Angel or venture capital investor, incubator/accelerator	51%	54%	67%[np]	38%	27%[2]
DOE (funding other than SBV award)	54%	54%	56%	54%	55%
Other federal agency or agencies	51%	54%	56%	46%	36%
State or local government or quasi-governmental agencies	26%[np]	23%	33%	23%	55%[p]
Universities and/or not-for-profit organizations	9%	15%	11%	0%	9%
Friends, other relationship-based funding	23%	15%	44%	15%	45%
Private sector source not listed above	17%	15%	11%	23%	27%
Personal Funds	34%	38%	22%	38%	N/A
Don't know	3%	0%	11%	0%	0%

[np] Statistically significantly different from non-participants at the 90% confidence level.

[p] Statistically significantly different from All SBV participants at the 90% confidence level.

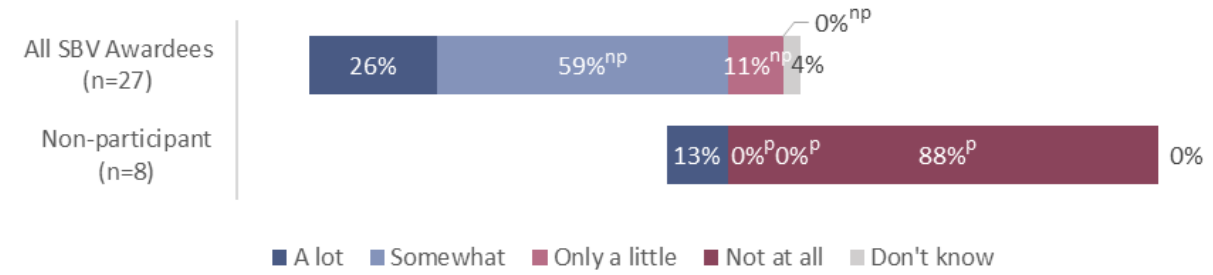
[2] Statistically significantly different from Round 2 awardees at the 90% confidence level.

Figure 38: SBV Experience's Influence on Source or Amount of Non-SBV Funding for Technology Development or Commercialization



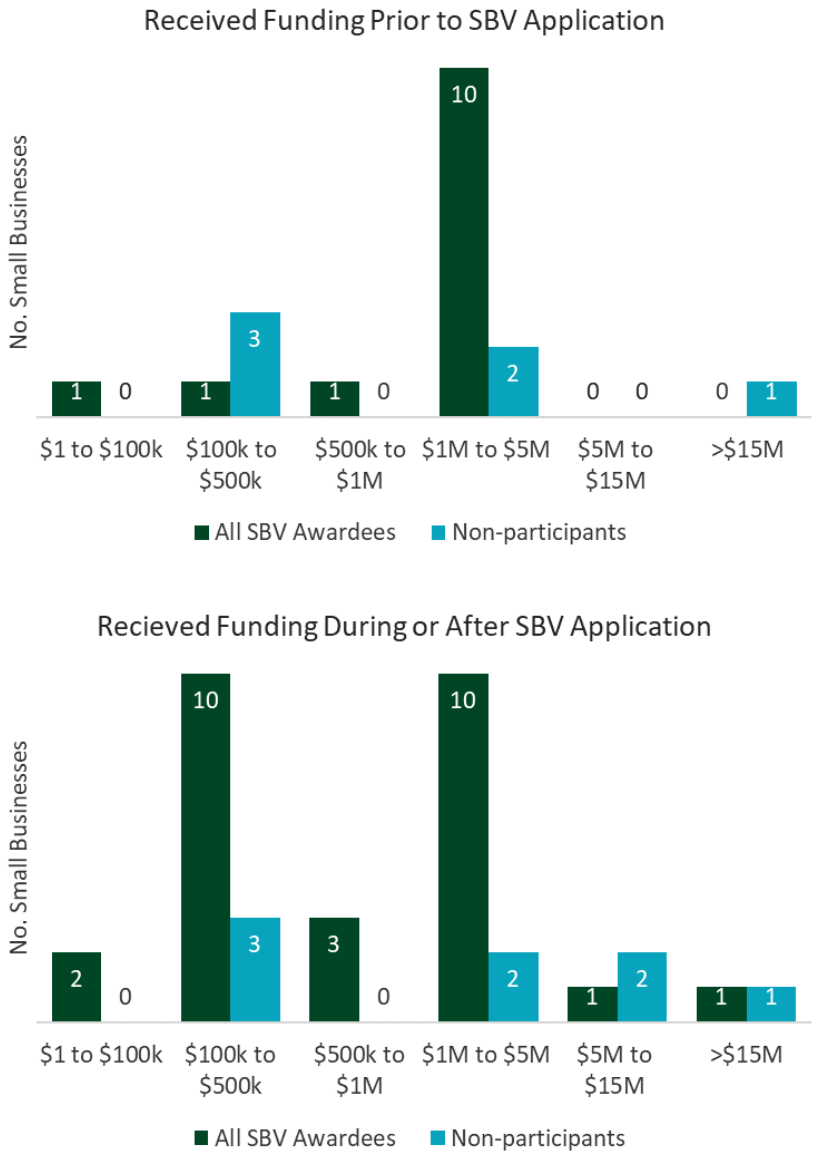
[np] Statistically significantly different from non-participants at the 90% confidence level.
[p] Statistically significantly different from All SBV participants at the 90% confidence level.
[1] Statistically significantly different from Round 1 awardees at the 90% confidence level.
[2] Statistically 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 39: SBV Program's Influence on Amount of Non-SBV Funding Received for Technology Development or Commercialization



[np] Statistically significantly different from non-participants at the 90% confidence level.
[p] Statistically significantly different from All SBV participants at the 90% confidence level.

Figure 40: Estimated Amounts of Follow-on Funding Received, All Sources



[1] Not tested for statistical difference due to small samples sizes.

Table 34: Non-SBV Funding Percentage, Received Funding Prior to SBV Application[1]

Funding Source	All SBV Awardees (n=13)		Round 1 (n=6)		Round 2 (n=4)		Round 3 (n=3)		Non-participants (n=6)	
	Range	Wtg. Mean	Range	Wtg. Mean	Range	Wtg. Mean	Range	Wtg. Mean	Range	Wtg. Mean
Private	0-1	0.50	0.15-1	0.43	0-1	0.53	0-0.90	0.67	0-0.70	0.48
Government (non-SBV)	0-1	0.48	0-0.85	0.53	0-1	0.47	0.10-1	0.33	0.30-1	0.52

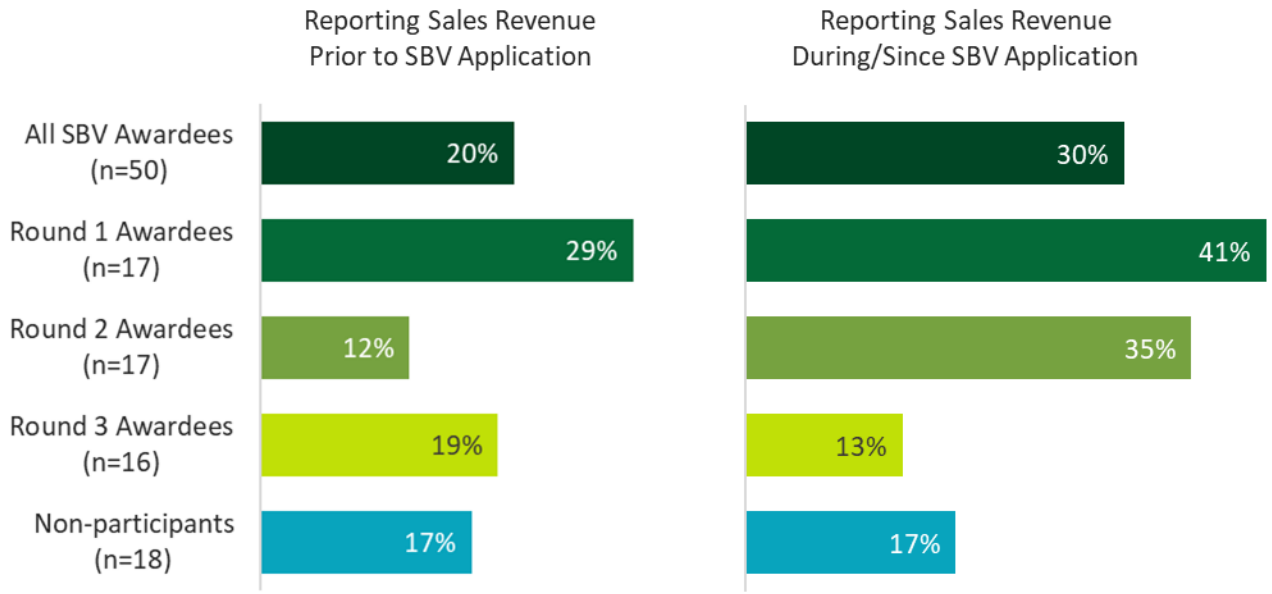
[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

Table 35: Non-SBV Funding Percentage, Received Funding During or After to SBV Application [1]

Funding Source	All SBV Awardees (n=27)		Round 1 (n=10)		Round 2 (n=5)		Round 3 (n=12)		Non-participants (n=8)	
	Range	Wtg. Mean	Range	Wtg. Mean	Range	Wtg. Mean	Range	Wtg. Mean	Range	Wtg. Mean
Private	0-1	0.59	0-0.8	0.45	0-1	0.67	0-1	0.63	0-1	0.35
Government (non-SBV)	0-1	0.40	0.5-1	0.51	0-1	0.33	0-1	0.37	0-1	0.65

[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

Figure 41: Percent of Respondents Reporting Sales (multiple responses permitted) [1]

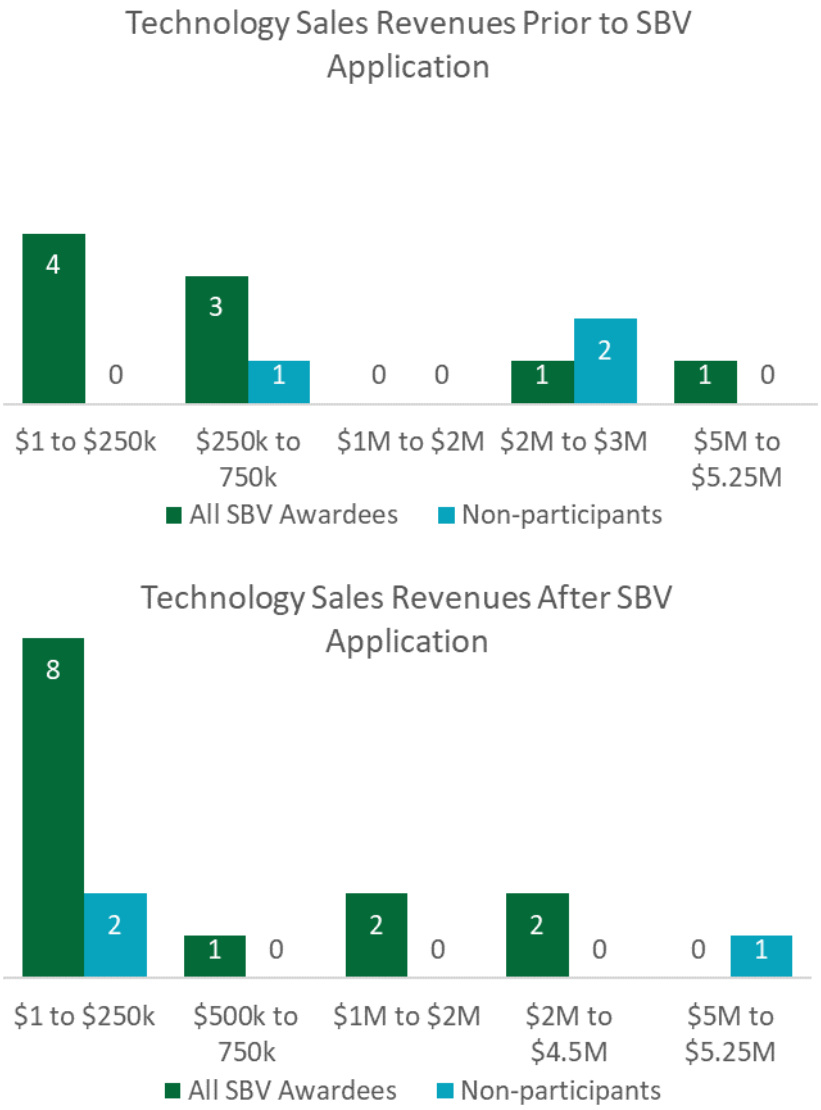


[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

Table 36: Reason for SBV Use in Market but No Revenue

	All SBV Participants (n=11)	Non-participants (n=3)
Marketing stage with samples/prototypes	4	0
Technology (or a component of the technology) in use in other markets	3	0
Tested but not commercially viable	1	1
Technology is in development stage	0	2
Researching applications for technology	1	0
Competing product already in other markets	1	0
Customer is waiting for funding	1	0

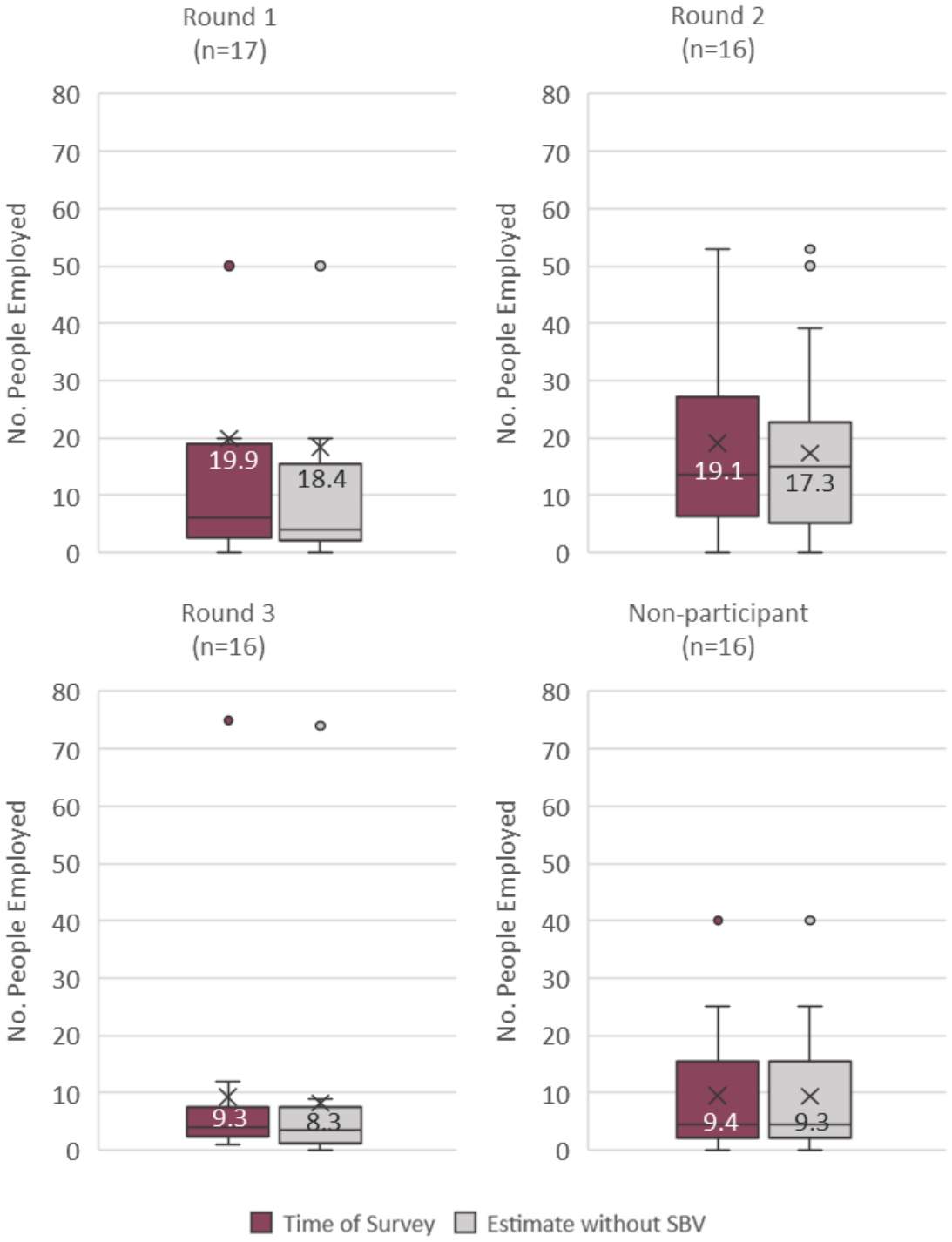
Figure 42: Technology Sales Revenues



[1] Not tested for statistical difference due to small samples sizes.

C.3.4 Employment Effects

Figure 43: Number Employed at Respondent's Firm Before and After SBV Award[1,2,3]



[1] X indicates the mean

[2] Respondents who indicated their firm had been acquired as a result of the SBV program (One (1) Round 2 Awardee with 700 employees and one (1) Non-participant with 400 employees) were excluded from reporting.

[3] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

C.3.5 Other Considerations

Table 37: Number of Patents, Copyrights, Trademarks, and/or Scientific Publications Applied for/Submitted

Number Applied for/Submitted	All SBV Awardees (n=43)		Round 1 (n=15)		Round 2 (n=13)		Round 3 (n=15)		Non-participants (n=16)	
	Range	% Responding > 0	Range	% Responding > 0	Range	% Responding > 0	Range	% Responding > 0	Range	% Responding > 0
Patents	0-8	42%[np]	0-8	53%[np]	0-7	38%[np]	0-3	33%[np]	0-6	81%[p,1,2,3]
Copyrights	0-0	0%[np]	0-0	0%[np]	0-0	0%[np]	0-0	0%[np]	0-1	19%[p,1,2,3]
Trademarks	0-2	9%	0-0	0%[np]	0-2	23%[1]	0-1	7%	0-1	25%[1]
Scientific/Technical Publications	0-3	35%	0-3	40%	0-3	31%	0-1	33%	0-8	44%

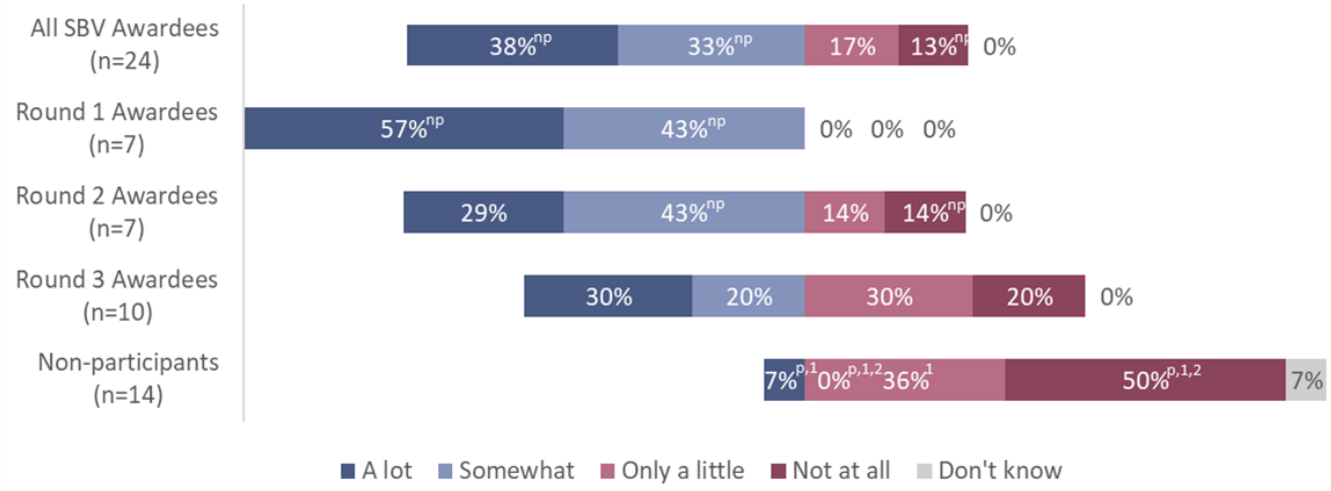
[np] Statistically significantly different from non-participants at the 90% confidence level.
[p] Statistically significantly different from All SBV participants at the 90% confidence level.
[1] Statistically significantly different from Round 1 awardees at the 90% confidence level.
[2] Statistically 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: Number of Patents, Copyrights, Trademarks, and/or Scientific Publications Received/Published

Number Received/Published	All SBV Awardees (n=43)		Round 1 (n=15)		Round 2 (n=13)		Round 3 (n=15)		Non-participants (n=16)	
	Range	% Responding > 0	Range	% Responding > 0	Range	% Responding > 0	Range	% Responding > 0	Range	% Responding > 0
Patents	0-3	28%	0-2	40%	0-3	23%	0-1	20%	0-8	44%
Copyrights	0-0	0%	0-0	0%	0-0	0%	0-0	0%	0-2	13%
Trademarks	0-1	7%	0-0	0%[np]	0-1	15%	0-1	7%	0-2	19%[1]
Scientific/Technical Publications	0-4	33%	0-4	33%[2]	0-1	8%[1,np]	0-1	27%	0-9	44%[2]

[np] Statistically significantly different from non-participants at the 90% confidence level.
[p] Statistically significantly different from All SBV 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.

Figure 44: SBV Experience Contribution to Patents, Copyrights, Trademarks, or Publications



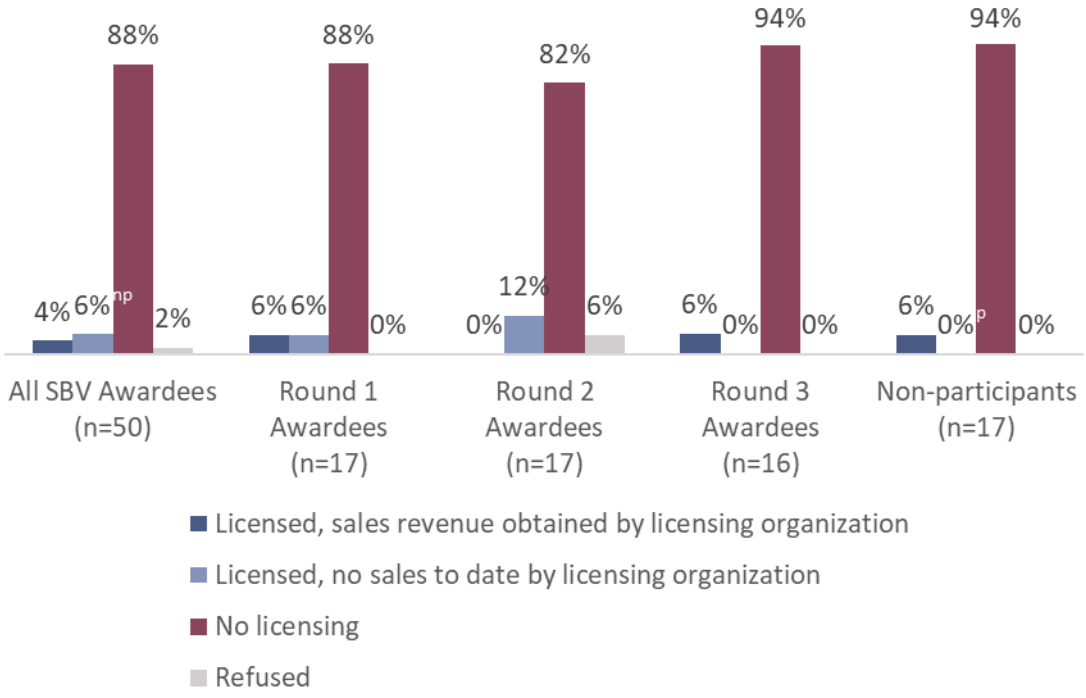
[np] Statistically significantly different from non-participants at the 90% confidence level.
[p] Statistically significantly different from All SBV participants at the 90% confidence level.
[1] Statistically significantly different from Round 1 awardees at the 90% confidence level.
[2] Statistically significantly different from Round 2 awardees at the 90% confidence level.

Table 39: Initial Public Offerings, Spin Offs, and Mergers

	All SBV Awardees (n = 50)	Round 1 Awardees (n = 17)	Round 2 Awardees (n = 17)	Round 3 Awardees (n=16)	Non-participants (n=18)
Planning to make an initial public offering within a year	6%	6%	12%	0%	11%
Established one or more spin off companies	4%	0%[np]	12%	0%[np]	17%[1,3]
Been acquired by/merged with another firm	2%	0%	6%	0%	6%
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.
[3] Statistically significantly different from Round 3 awardees at the 90% confidence level.

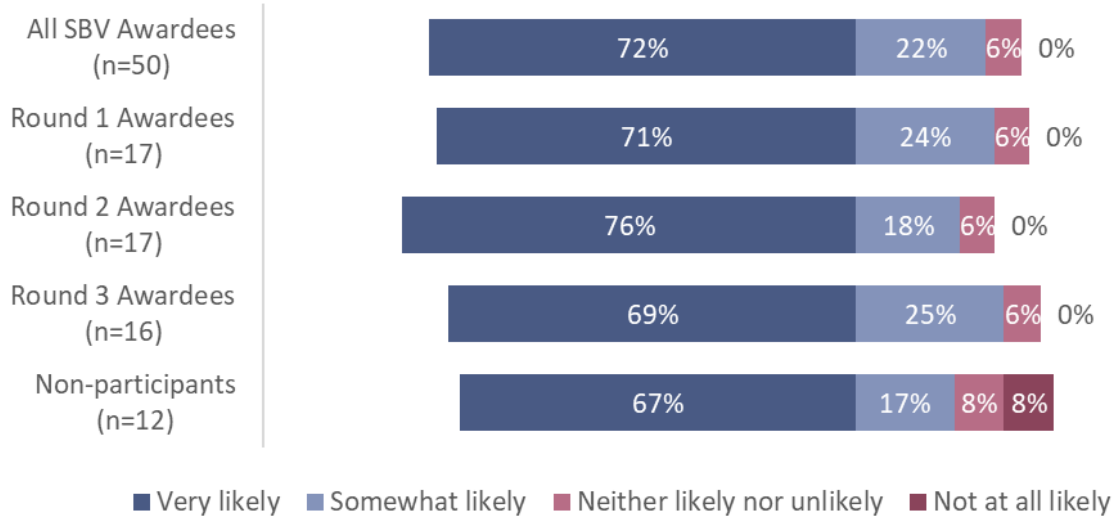
Figure 45: Licensing with SBV Technology



[np] Statistically significantly different from non-participants at the 90% confidence level.
[p] Statistically significantly different from All SBV awardees at the 90% confidence level.

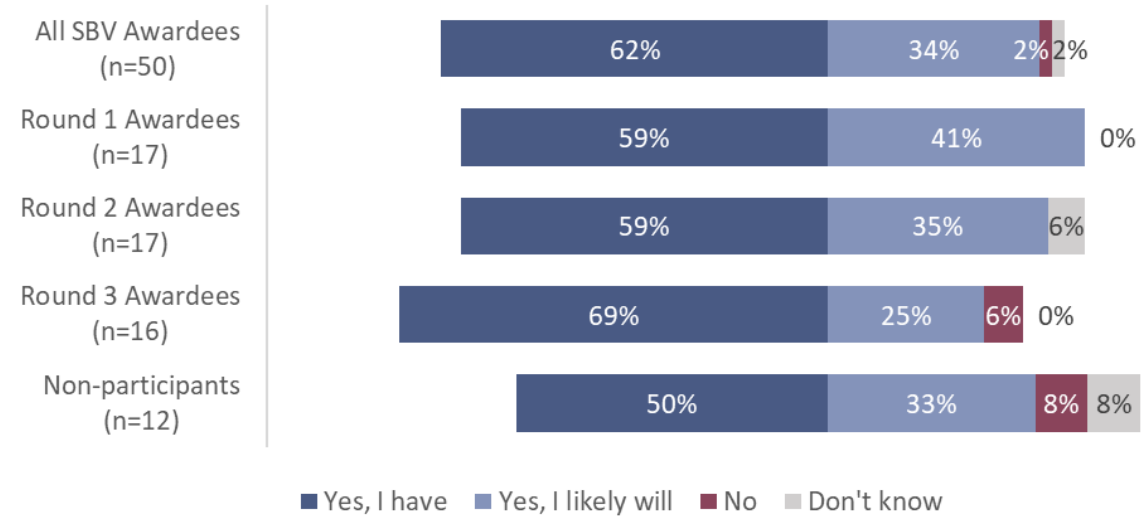
C.4 ENGAGEMENT WITH SMALL BUSINESSES

Figure 46: Likelihood that You Will Work with the Labs Again [1]



[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

Figure 47: Respondent Recommendations to Colleagues or Other Small Businesses that they Work with the Labs [1]



[1] All rounds of participants are not significantly different from non-participants at the 90% confidence level.

C.5 Association of Commercialization Outcomes with Other Factors

In the previous SBV report, with feedback from the peer review process, the team identified several areas for further consideration and examination in this report. We examined the association of the following factors with key commercialization outcomes:

- technology type (software vs. hardware)
- starting TRL (conceptualization and proof of concept (TRL 1 to 4) vs. validation or commercialization (TRL 5 to 9)
- prior commercialization experience
- size of SBV award (up to $100k, $100k-$200k, over $200k (n=13)

Table 40 presents our analysis of the association between technology type and commercialization outcome. There appears to be an association with software technologies and use in any market and their target markets, but no other statistically significant differences between hardware and software technologies.

Table 40: Technology Type and Commercialization Outcomes

Commercialization Outcome	SBV Awardees (n=50)		Non-participants (n=18)	
	Hardware (n=32)	Software (n=18)	Hardware (n=11)	Software (n=7)
Sales during or after award/application	22%	44%	27%	0%
Any market use prior to award/application	38%	33%	36%	14%
Any market use after award/application	47%*	83%	55%	14%
Use in target market post award/application	25%*	56%	18%	14%
At least one stage of TRL development change following the award/application	81%	94%	82%	57%
Received follow-on funding after the award/application	59%	61%	64%	43%
Published or received a patent, trademark, or copyright after the award/application	22%	8%	33%	17%

*Statistically significantly different than participants with a software technology at the 90% confidence level.

Awardees with more advanced starting TRLs were more likely to have achieved sales after receiving the SBV award and have their technology in use in any market (Table 41).

Table 41: Starting TRL and Commercialization Outcomes

Commercialization Outcome	SBV Awardees (n=50)		Non-participants (n=18)	
	Concept (n=38)	Validation/ Commercialization (n=12)	Concept (n=12)	Validation/ Commercialization (n=6)
Sales during or after award/application	21%*	58%	17%	17%
Any market use prior to award/application	32%	50%	25%	33%
Any market use after award/application	53%*	83%	50%	17%
Use in target market post award/application	29%	58%	17%	17%
At least one stage of TRL development change following the award/application	89%	75%	83%	50%
Received follow-on funding after the award/application	63%	50%	58%	50%
Published or received a patent, trademark, or copyright after the award/application	26%	42%	50%	50%

*Statistically significantly different than the validation/commercialization stage at the 90% confidence level.

Awardees with previous commercialization experience are more likely to have achieved sales after receiving the SBV award, have their technology in use in any market, and have IP associated with their SBV technology (Table 42). However, awardees without previous experience are more likely to have advanced at least one TRL level and received follow-on funding.

Table 42: Commercialization Experience and Commercialization Outcomes

Commercialization Outcome	SBV Awardees (n=50)		Non-participants (n=18)	
	Experience (n=43)	No Experience (n=7)	Experience (n=15)	No Experience (n=0)
Sales during or after award/application	35%*	0%	20%	--
Any market use prior to award/application	40%	14%	33%	--
Any market use after award/application	65%*	29%	47%	--
Use in target market post award/application	40%	14%	20%	--
At least one stage of TRL development change following the award/application	84%*	100%	73%	--
Received follow-on funding after the award/application	56%*	86%	67%	--
Published or received a patent, trademark, or copyright after the award/application	30%*	0%	44%	--

*Statistically significantly different than participants at the validation/commercialization stage at the 90% confidence level.

The size of the SBV award does not appear to be associated with any commercialization outcomes (Table 43).

Table 43: Size of SBV Award and Commercialization Outcomes

Commercialization Outcome	SBV Awardees (n=50)		
	Up to $100k (n=15)	$100k-$200k (n=22)	Over $200k (n=13)
Sales during or after award/application	33%	23%	38%
Any market use prior to award/application	27%	50%	23%
Any market use after award/application	53%	64%	62%
Use in target market post award/application	40%	36%	31%
At least one stage of TRL development change following the award/application	87%	82%	92%
Received follow-on funding after the award/application	67%	59%	54%
Published or received a patent, trademark, or copyright after the award/application	40%	23%	31%

Appendix D Summary of Key Findings from Previous Reports

This Appendix provides a summary of key findings for goal 1 (lab engagement) and goal 2 (lab awareness) from the 2016 SBV evaluation report and the 2018 impact and early outcomes report.[62]

D.1 Goal 1 and 2 Findings

1. **Small businesses gained awareness of the capabilities of the national laboratory system and the availability of lab technical resources to assist private firms.** The SBV website clearly described that the resources of the national lab system are available to the private sector. It clearly described the capabilities offered by each lab in the nine technology areas for which SBV offers vouchers. By the end of Round 2, 1,748 people registered at the pilot's CAP and submitted 849 RFAs. The pilot received submittals from small businesses in 46 states and the District of Columbia for vouchers in all nine technology areas.
2. **Applicants and awardees included very small firms, young firms, and firms new to a lab relationship.** Two thirds of applicants were firms with less than six employees. Applicants had been in business an average of seven years, while awardees had been in business an average of eight years. Fifty-five percent of applicants and 32% of awardees had not previously worked with the lab. A correlation analysis of the merit review scores attained by applicants and their awareness of lab capabilities supports an interpretation that a small business with a good idea does not need to know much about the labs to have its application be judged meritorious.
3. **Pilot processes made it easy for small businesses to participate.** Small businesses completed a short (about five-page) request for assistance, submitted the request through an application portal, and were notified of whether they were selected as a semi-finalist. The pilot matched the semi-finalists with the lab most appropriate to conduct the research, and the lab assigned a PI to the potential project. The PI worked with the firm to prepare a very brief presentation to the voucher decision-makers, which the lab presented on the firm's behalf. The pilot created standard research contracts to be used for all voucher awards. Small businesses knew the contract terms at the time of submittal and all parties agree to no negotiation of the terms.

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[62] Research Into Action, NMR, and Gretchen Jordan. 2016. Baseline and Process Evaluation of Small Business Vouchers Pilot. DOE/EE-1574. SBV Baseline and Process Evaluation. Some of the statistics presented here were updated in other sections of the report to include all three rounds.

[3] Research Into Action, NMR and Gretchen Jordan. 2018. Early Stage Outcomes and Impacts, Round 1, 2, & 3 Awardees DOE/EE-1576. Early Stage Outcomes Evaluation

4. **Labs Gain Knowledge of Small Businesses.** Interviewed lab pilot managers commonly attributed the pilot to increasing their knowledge of small business, one of the pilot's goals. Some lab managers stated that a few of the PIs for vouchers they were working on reported gaining insights that they would carry into their other research. Some lab managers described new non-SBV partnerships with small businesses that had resulted from the pilot.
5. **Labs Gain New Research Perspectives.** The three managers stated they had awarded vouchers to unanticipated innovations not encompassed by their technology road map and that their increased understanding of small businesses has already begun to influence their research activities. Several interviewed lab pilot managers reported that their participation in the pilot has led to new non-pilot partnerships or possible partnerships. Pilot managers at two labs described the establishment of ongoing relationships with small businesses that have sought funding from sources other than SBV

D.1.1 Lab Engagement Metrics, Early Stage Outcomes Evaluation[63]

Regarding the goal of the engagement of small businesses, nearly all awardees reported 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). 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 positively rated the time it took to contract.

SBV awardees reported 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.

[63] [3] Research Into Action, NMR and Gretchen Jordan. 2018. Early Stage Outcomes and Impacts, Round 1, 2, & 3 Awardees DOE/EE-1576. Early Stage Outcomes Evaluation

Table 44: Lab Engagement Metrics, Early Stage Outcomes Evaluation

Metric	Indicator	Awardees	Non-participants
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]
Satisfaction with the Central Assistance Portal, 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%

[1] In the interest of minimizing survey length and burden, the study did not seek comparable information from non-participants.
[2] Comparative results for non-participants are not reported because there were only a few who responded to this part of the study survey
[3]Non-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.

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