

NSF Sustainable Building Science Technology

Expanding Lifelong STEM Career Pathways in Sustainable Building Science Technology



An NSF/ATE Project DUE 1406320

EVALUATION REPORT YEAR 2: July 1, 2015 to June 30, 2016



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EXECUTIVE SUMMARY

The Expanding Lifelong STEM Career Pathways in Sustainable Building Science Technology (SBST) Project received a three-year award from NSF ATE (DUE 1406320) in July 2014, with the grant ending on June 30, 2017. South Seattle College in Seattle, WA is the SBST Project fiscal agent.

SBST is a project whose mission is to advance technical education by developing a Baccalaureate of Applied Science in Sustainable Building Science Technology. SBST serves the students and faculty of South Seattle College, community colleges in the Puget Sound Region and other ATE projects and centers. Additionally, SBST will provide a model for Baccalaureate of Applied Science (BAS) degree programs in STEM for community colleges and universities across the U.S.

In year two, the team and evaluator collaborated to simplify and clarify the evaluation plan for the project. The goal was to decrease the amount of overlap between the annual report and the evaluation report. This was accomplished by increasing the focus of the evaluation report on outcomes and impacts, and the focus of the annual report on activities and results.

The external evaluator, in collaboration with the project leadership, designed a survey for students completing their senior year (Cohort 1). The survey was completed by 7 of the 15 students in Cohort 1 for a response rate of 48.7%. Additionally, pre-and-post-event surveys were developed for the SBST Summer Institute, held July 11-15, 2016, revised by the SBST team, and conducted at the Institute. Survey data were analyzed and correlated to address the evaluation questions.

The project is behind in enrollments into the BAS program and on recruitment of veterans. In year two, there were 15 students in Cohort 1 (Seniors) and 18 students in Cohort 2 (Juniors) of the BAS program in Sustainable Building Science Technology. This is just under half way to the goal of 75 enrollees. To meet this goal, Cohort 3 needs to have 43 participants. The project is exceeding its goals with respect to recruiting females. Regarding veterans, there were two enrolled this year toward the target of 9 the three years.

There were significant recruiting efforts by project partners and staff to address this. In year two, the project reached 1393 individuals, with over 600 incumbent workers who would be prime candidates for the program. In addition, the project did an outstanding job of developing 12 new articulation agreements with community colleges in the state for AS degree students to attend the SSC BAS program.

South Seattle College reported a persistence rate of 89% for the BAS in Sustainable Building Science Technology, an increase of 2.3% over that in year two.

SBST conducted its first summer institute with nine participants, four from high schools and five from community colleges. The institute was well received with high ratings for quality and 100% intending to use institute materials in their classrooms.

Based on review of project documentation, observation, interviews with staff and surveys of stakeholders, SBST is meeting or exceeding expectations, and the project is making progress toward its goals.

PI Holly Moore and the SBST team are to be commended for their flexibility, innovation and persistence and for their commitment to sustainable building science technician education in the region and across the country.

INTRODUCTION

The Expanding Lifelong STEM Career Pathways in Sustainable Building Science Technology (SBST) Project received a three-year award from NSF ATE (DUE 1406320) in July 2014, with the grant ending on June 30, 2017. South Seattle College in Seattle, WA is the SBST Project fiscal agent.

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This report covers the second year of the SBST grant, for the time period July 1, 2015 to June 30, 2016.

Project Goals

The project has two goals:

- Goal 1:** Design a Baccalaureate of Applied Science in Sustainable Building Science Technology based in building science and incorporating energy policy and energy codes.
- Goal 2:** Build and expand recruiting pipelines for future students and workers including minorities, women, veterans, and high school students.

Objective 1: Develop innovative bachelors of applied science curriculum in sustainable building science technology.

Objective 2: Recruit, retain and graduate students from industry, people of color, veterans, women and other career-changers.

Objective 3: Grow the STEM pipeline by exposing high school students to the education and career opportunities in sustainable building science technology.

Purpose and Design of the Evaluation

In year two, the team and evaluator collaborated to simplify and clarify the evaluation plan for the project. The goal was to decrease the amount of overlap between the annual report and the evaluation report. This was accomplished by increasing the focus of the evaluation report on outcomes and impacts, and the focus of the annual report on activities and results. These efforts resulted in the following evaluative questions.

1. To what degree did SBST's work lead to improvement of training and education of the building science technician workforce?
2. To what extent did SBST improve recruitment and retention of minorities, women, veterans and high school students with respect to the SBST BAS?
3. To what degree was there an increase in industry support of sustainable building science technology education?
4. What impact did the project have on high school student interest in sustainable building science technology education and career opportunities?

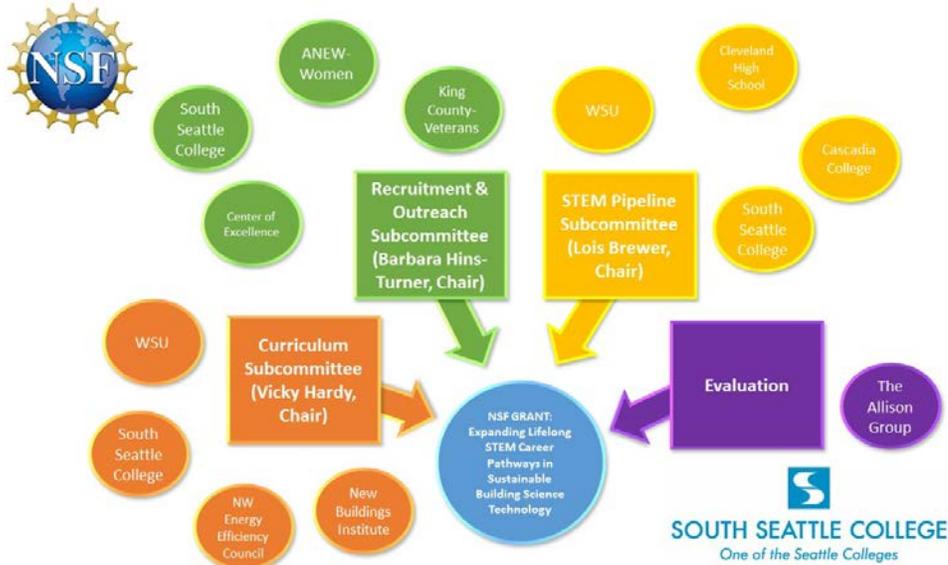
The results of the project documentation and all of the surveys were reviewed, analyzed and then discussed with the PI. The larger themes that emerged are described in the report which follows.

Surveys were both qualitative and quantitative in nature, utilizing Likert scales, multiple choice responses and open-ended questions. Representative comments were selected and are in the report narrative; the full sets of comments are available upon request. Data analysis included adjustment to account for response rate variation between the pre and post assessment.

Standard qualitative analysis methods were used to examine and analyze the data collected from open-ended questions in the surveys. The goal was to identify themes in the responses. The strategy to identify themes used multiple techniques in a sequential manner:

1. Responses were reviewed to identify key words and concepts.
2. Key words were grouped.
3. Comparisons were made across respondents.
4. Word repetitions/key words and concepts were analyzed.

PROJECT MANAGEMENT AND IMPLEMENTATION



PI Holly Moore from South Seattle College, Co-PI Ken Eklund from Washington State University and Co-PI and NSF Grant Director Alison Pugh provide leadership for this project. The project staff was stable in year two, with PI Holly Moore, Grant Director Alison Pugh and Lead Faculty Victoria Hardy.

The Director conducted quarterly meetings with the project partners in which progress toward goals was reviewed and work plans were confirmed. The external evaluator attended two of the meetings and made a presentation on the theoretical foundations and implementation plans for the evaluation of the project.

SBST Project Metrics

	Year 1		Year 2		Year 3		Total End of Grant	
	Target	Actual	Target	Actual	Target	Actual	Target	To-Date
# of Students that enroll in the program	n/a	15	n/a	18	n/a		75	33
# of students that complete the program	n/a	n/a	n/a	2	n/a		40	2
# of veterans referred by King County	3	0	3	2	3		9	2
# of women referred by ANEW	3	4	3	5	3		9	9
# of certifications embedded in the program	n/a	n/a	n/a	1	n/a		3	1
# of summer workshops hosted for HS teachers	n/a	n/a	1	1	1		2	1
# of HS teachers attending summer workshops	n/a	n/a	25	8	25		50	8

The project is behind in its metrics for students enrolled in the program, completers, veterans enrolled, embedded certifications and # high school teachers attending summer workshops. However, Co-PI Pugh made great strides in terms of outreach and project activities this past year, and there is every possibility that many of these will be met or nearly met.

QUESTION 1: To what degree did SBST's work lead to improvement of training and education of the building science technician workforce?

Baccalaureate of Applied Science in Sustainable Building Science Technology

The addition of the BAS in Sustainable Building Science Technology provides a unique avenue to students and workers to enter and progress in sustainable building science careers. The course sequencing and student outcomes for the BAS in Sustainable Building Science Technology were completed and approved by the State of Washington before the grant was funded. However, the content and materials for the first year of course offerings were developed in year one of the grant. A summary of the program is found in Appendix 2.

Hybrid courses for the BAS in Sustainable Building Science Technology was defined as 80% on-line and 20% on-site at SSC for team project meetings, guest lectures and field trips. The development of websites for the individual courses allowed for on-line access for all courses.

The SBST project provides access for students in the BAS in Sustainable Building Science Technology to community learning laboratories. Instead of having students work in facsimile laboratories at SSC, the grant leveraged SSC's development of partnerships with companies that provide learning spaces for a wide variety of hands on experiences for BAS students. In year two, three of the courses were made competency- and module-based. Additionally, the project completed syllabi and websites for the remaining six courses in the BAS.

Four measures were used to determine the degree to which the project improved training and education of the building science technician workforce:

- Enrollment of BAS students
- Completion of BAS students
- # of students hired in the field of sustainable buildings
- Impact on Students

Enrollment and Completion of BAS Students

In year two, there were 15 students in Cohort 1 (Seniors) and 18 students in Cohort 2 (Juniors) of the BAS program in Sustainable Building Science Technology. This is just under half way to the goal of 75 enrollees. To meet this goal, Cohort 3 needs to have 43 participants.

In year two, South Seattle College reported 2 completers in its institutional reports. Many of the students in cohort 1 still needed some general education classes to complete the degree. By fall quarter, most of the students in Cohort 1 will be completers, which will bring this number up to 15 of the target of 40.

of Students Hired

The information for number of students hired is not yet available, but will be gathered in the final year of the grant.

Impact on Students

Student Learning

Students were asked to rate the degree to which the SBST BAS program led to increased knowledge and understanding of building science. Respondents reported their level of learning with respect to a series of concepts and topics, using a five-point Likert scale. Ratings were assigned a numerical value as follows:

Very Much = 4

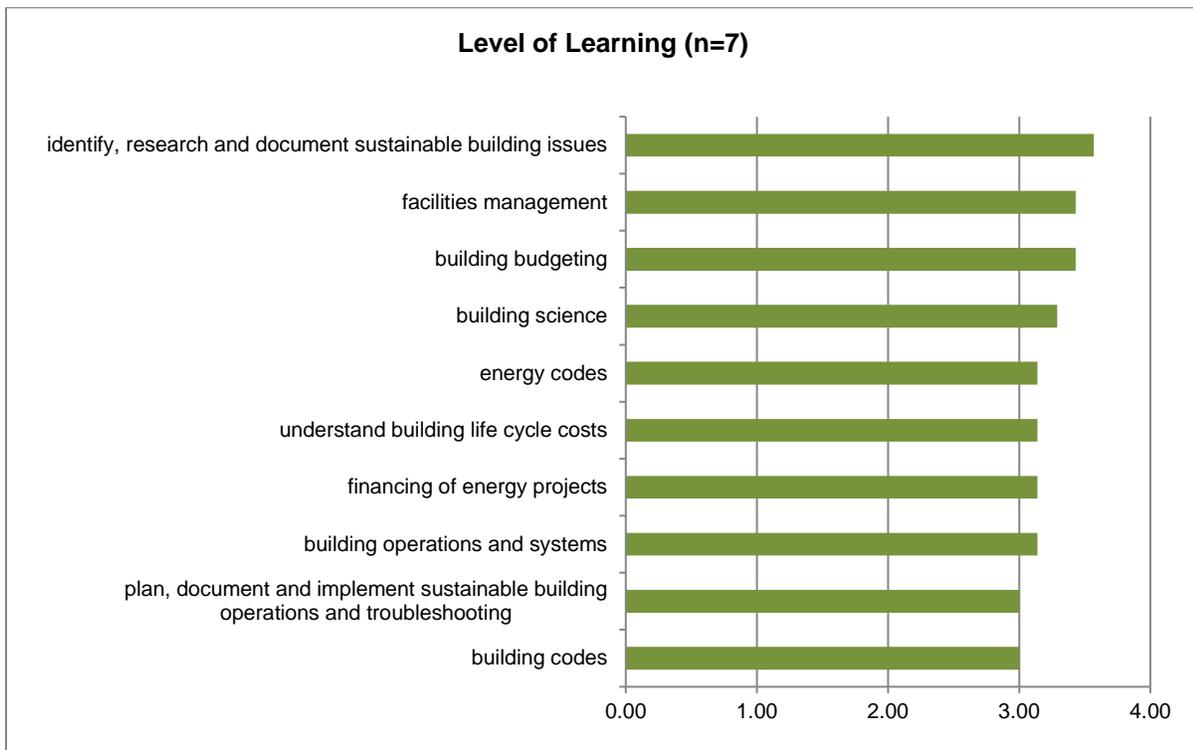
Quite a Lot = 3

Somewhat = 2

Slightly = 1

Not at All = 0

Means were calculated and overall, students rated the increase on their knowledge and understanding at 3.23 out of a possible 4.00. The top three topics were: 1) identify, research and document sustainable building issues; 2) building budgeting; 3) facilities management. The chart below shows the ratings for all concepts and topics.



Additionally, respondents rated their learning with respect to workplace skills such as team work and presentation skills at 3.29.

Careers

When asked about careers, using the same Likert scale respondents rated their increase in knowledge of building science careers at 3.14 and increased understanding of the work of building science professionals at 3.43 out of a possible 4.00.

Students reported that participation in the SBST BAS increased their confidence in their ability to advance their careers. The mean rating was 3.57, again out of a possible 4.0.

Quality and Utility of the BAS Program

Students rated the quality of the SBST BAS program very highly. Statements about aspects of the class were provided along with a four-point Likert scale; the ratings were converted to numerical values as follows:

- Excellent=4
- Good=3
- Fair=2
- Poor=1

The means for each statement were calculated. Nearly all aspects of the program were rated as excellent; one aspect was rated as good (quality of the instructional facilities). Mean scores are shown in the table below.

Quality of the BAS Program, sorted by means n=7	
Statement	Ratings 4=Excellent 1=Poor
The quality of the teachers.	4.00
Opportunities to learn about real world applications in sustainable building science.	3.86
The quality of the online experience.	3.86
The quality of the field trip experiences.	3.86
Opportunities to build your skills in planning, documenting and implementing building management operations.	3.71
Interactions with faculty and staff.	3.57
Opportunities to build your skills in identifying needs, researching solutions and isolating technical problems by applying the troubleshooting process to technical issues and business needs.	3.57
Opportunities to build your skills in sustainable building science.	3.57
Opportunities to learn about professions and careers in building science.	3.57
The quality of the instructional facilities.	3.43

It is noted that rated highest was *quality of the teachers*, receiving a perfect 4.0. This was closely followed by *Opportunities to learn about real world applications in sustainable building science*; *Quality of the online experience*; and *Quality of the field trip experiences*, all of which had a mean rating of 3.86.

Students were also given 20 features of the program and were asked to rate their usefulness in preparing them to be successful in a sustainable building science career. A five-point Likert scale was used and the ratings were converted to numerical values as follows:

- Very Useful = 4
- Quite Useful = 3
- Somewhat Useful = 2
- Not Very Useful = 1
- Not Useful at All = 0

The means for each statement were calculated. All features were rated as useful. Mean scores are shown in the table below.

Utility of the BAS Program, sorted by means n=7	
Statement	Ratings 4=Very Useful 0=Not Useful at All
Establishing rapport with team mates	4.00
Listening to ideas of others on the team	3.86
Establishing rapport with companies and individuals in industry / the community	3.86
Building science	3.86
Building components and systems	3.86
Energy analysis and auditing	3.86
Facilities management	3.86
Professional communication	3.86
Presentations	3.71
Accepting feedback and constructive criticism	3.71
Fiscal management for facilities managers	3.71
Building controls for energy efficiency	3.57
Utility rates, regulation and economics	3.57
Building codes	3.43
Energy policy	3.43
Lighting	3.29
Financing energy efficiency and renewable energy	3.29
Capstone	3.29
Internship(s)	3.14
Building energy codes	3.00

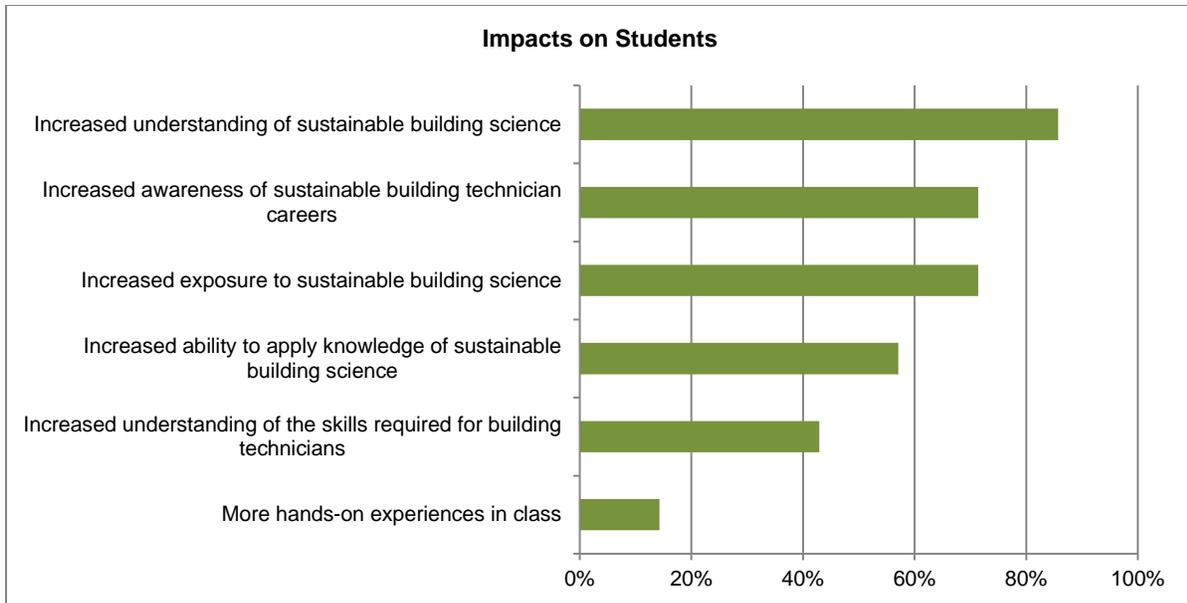
Students unanimously agreed that the most useful feature was *establishing rapport with team mates* and the least useful was *building energy codes*. Interestingly, the next least useful feature was internships.

The project may want to consider following up with some students to obtain additional information as to their perspective on the usefulness of the various features of the program.

Impact on High School and Community College Classrooms and Students

SBST conducted a summer teacher institute designed for high school teachers with the goal that they learn about concepts and engage with case-studies, tools, and activities that they could use to build a teaching unit for their students. There were eight participants, four from community colleges and four from high schools. Participants were surveyed at the end of the institute and were asked how likely they were to implement the ideas and concepts learned at the institute in their classes. 85.7% indicated that they were extremely likely and 100% indicated that they were extremely or somewhat likely to do so. Participants estimated that their participation in the institute would impact 390 students in the coming year.

Additionally, respondents were asked to report the manner in which they believed students would be impacted. The top two were 1) increased understanding of building science and 2) increased awareness of sustainable building technician careers.



Energy Educators Association (EEA)

The Energy Educators Association (EEA) was formed as part of the NSF grant, Meeting the Challenge of Energy Management in a Carbon-Constrained World (DUE 1002931) at Edmonds Community College. Alison Pugh was the PI for that grant, and the EEA was initiated and managed by the project for four years. Director Pugh convened the EEA at the annual conference (Energy and Construction Best Practices Summit) sponsored by project partner, the Center of Excellence for Clean Energy.

The Energy Educators Association (EEA) is a regional professional group whose mission is to address the challenges of a carbon-constrained world by supporting energy educators. Currently, the EEA's activities focus on the following categories: collaboration, support for program/course development, and creating infrastructure for the long-term viability of the EEA and its members. The project invited its partners and collaborating institutions to a meeting at the 11th Annual Energy and Construction Best Practices Summit in May; 8 attendees learned about the history of the organization and discussed next steps for the EEA.

QUESTION 2: To what extent did SBST improve recruitment and retention of minorities, women, veterans and high school students with respect to the SBST BAS?

Veterans and Women

SBST project metrics were 3 women and 3 veterans in Cohort 2, and the project was much more successful in year two regarding this target, with 2 veterans and 5 women enrolled in the program. In Cohort 2 the number of women and veterans grew as shown in the table below.

Veterans and Women in BAS Program (n=33)			
	Cohort 1 (2014-15)	Cohort 2 (2015-16)	% Change
Veterans	0	2	n/a
Women	4	5	25%

With its BAS cohorts at 27% female, SBST was well above the national average in terms of recruiting women to the program. Data produced by the NSF ATE National Center, BEST (Building Efficiency for a Sustainable Tomorrow), showed that only 4% of Building Science programs across the country are female.

This is despite the prerequisite for the BAS in Sustainable Building Science Technology for at least two years related work experience. In a field that is traditionally dominated by white males, the project has found some barriers to recruiting women and minorities to the program. In Year Two, SBST secured the agreement of the college to count volunteer experience toward that requirement and redoubled its efforts through ANEW, which focuses on women and minorities in the trades. There is every indication that the project will exceed their target for females.

The project improved greatly in terms of recruiting veterans in year two, and met its target of three veterans recruited. One had to drop from the program due to personal reasons. The success in year two is attributed to new marketing materials designed especially for veterans and mandatory evaluation for military transcripts for academic transfer of credits. The project will build on this success in year three by identifying and marketing specific related military skills that align with the SBST field in order to more clearly convey the pathway from the military to SBST careers.

Recruitment

The project significantly increased its outreach and recruiting efforts in year two, jumping from 22 events, meetings and activities last year to 55 this year and more than doubling the number of individuals it reached. Most of the outreach (97.4%) was to recruit participants for the SBST BAS program. Events ranged from community festivals and professional conferences to meetings with potential feeder colleges and veterans groups. The table below shows the number and variety of individuals contacted, totaling approximately 1,357 people.

Recruitment Outreach			
Contacts	# Year 1	# Year 2	% Change
Community College Instructors, Students, Admin	326	235	-27.9%
High School Students and Teachers		131	n/a
Business	75	651	768.0%
Municipal Facilities Management		201	n/a
Veterans	36	93	158.3%

The data indicates two major shifts in recruitment strategy: 1) increased focus on incumbent workers and 2) increased outreach to high school. The purpose of those shifts in strategy, combined with a general increase in emphasis on recruitment was to increase overall enrollment in the program in year three.

Articulation Agreements

The project did an outstanding job of developing articulation agreements with community colleges in the state for AS degree students to attend the SSC BAS program. This is a notoriously laborious process in Washington State, and Co-PI Pugh and her team are to be commended for their success in developing 12 new articulation agreements for a total of 13 (one from last year), which represents 72.2% of the colleges in the Puget Sound Region and 38.2% of colleges in the state overall.

Articulation Agreements Added 2015-16	
Bates Technical College	Facilities Maintenance ATA
Cascadia College	Environmental Technologies and Sustainable Practices AAS-T
Centralia College	Energy Technology - Power Operations AAS
Clover Park Technical College	Sustainable Building Science AAS-T
Edmonds Community College	Construction Management AAS-T
Lake Washington Institute of Technology	Architectural Technology AAS-T
North Seattle College	Architectural Engineering Drafting AAS
North Seattle College	HVAC Project Management AAS
Renton Technical College	Commercial Building Engineering AAS
Renton Technical College	Construction Management AAS-T
Renton Technical College	Engineering Design Technology AAS
Shoreline Community College	Clean Energy Technology & Entrepreneurship AAS

It will be important for the project to track how new enrollees heard about the program to see which of the recruitment efforts were most effective.

Retention

South Seattle College reported a persistence rate of 89% for the BAS in Sustainable Building Science Technology, an increase of 2.3% over that in year one. This compares favorably to a persistence rate of 75% found in a study of community colleges in Washington and Virginia, cited by the Community College Research Center (<http://csrc.tc.columbia.edu/Community-College-FAQs.html>). It compares even more favorably to project reporting that shows a 50% retention rate for hybrid courses.

This success is due primarily to the resources provided by South Seattle College to students in the program and to the use of a cohort model.

The college continued its investment in student retention in the BAS Sustainable Building Science Technology program by implementing a student services plan that included a student services manager to provide on-line and face-to-face support of students and a .25 FTE financial aid staffer to support students in the program. The college also offered support services including academic advising, drop-in tutoring, and one-on-one tutoring.

The program also provided flexible scheduling for students that included hybrid courses. Of the fifteen students enrolled in the program, eleven work full time and the hybrid format is essential to their participation. Additionally, the program employs a cohort model in which students move through the program together and form a learning community in which students support one another. Research shows that both of these strategies improve retention of students.

In a year-end survey of Cohort 1 students, respondents were asked to identify the importance of elements of the program structure to their success. Five elements were listed, and a five-point Likert scale with associated numerical values was used:

- Very Important = 4
- Quite Important = 3
- Somewhat Important = 2
- Not Very Important = 1
- Not Important at All = 0

Means were calculated and overall, students rated the structural elements as important or very important, with an average rating of 3.51 out of a possible 4.00. Most important to student was credit for prior learning from work experience, which was unanimously rated as very important by all respondents. The means for all structural elements are shown in the table below.

Importance of Structural Elements of the Program	
	Rating
Availability of credit for prior learning from work experience	4.00
Hybrid nature of the program	3.86
Non-traditional scheduling of the classes	3.71
Onsite advising	3.14
Onsite registration	2.86

In the second year of the project, the team placed a strong emphasis on recruiting students to the program in order to close the gap in meeting the metric of 75 students overall enrolled in the program. With the prerequisite of at least two years of work experience in the field in order to enter the program, the greater focus on incumbent workers was both strategic and practical. The number of incumbent workers increased by seven fold in year two and it will be interesting to see the impact on the number of enrollments.

QUESTION 3: To what degree was there an increase in industry support of sustainable building science technology education?

The BAS in Sustainable Building Science Technology was developed with industry input from the start. The Advisory Committee consisted of twelve leaders in the sustainable commercial building operations industry including BEE Consulting, LLC, CBRE, Inc., Green Operations Consulting, Vulcan, Inc., Architectural Testing, MacDonald-Miller Facility Solutions, Emerald Cities Seattle, Associate General Contractors, , Batt + Lear, Inc., GLY Construction, Inc., Sheraton Seattle Hotel and CLEAResult.

As previously stated in this report, the project vastly increased its recruitment efforts for the BAS program with incumbent workers with industry partners. In addition, the project continued to have high levels of industry support, including presentations, tours of facilities and internship opportunities.

In year two, New Buildings Institute developed a series of four modules, the completion of which lead to NBI certificate in FirstView, software that automatically creates a simplified building energy model that can quickly diagnose opportunities for improvement. The modules will be integrated into the BAS curriculum starting in year three so that any student in the program who successfully completes the modules will receive a certificate for FirstView Training.

Internships

In year one, 14 of 15 students were placed in internships, 11 of which were at the organizations in which they were already employed. In the student survey, internships were not rated very highly in terms of student perception of contribution to their success, and their placement at their existing places of employment was likely the reason for this.

Consequently, in year two the project kept the internship option, but added the option the development of sustainability projects within students' companies that could both meet the requirement and bring merit to the student. This option seemed to bring greater success to students and the project will gather more data on its efficacy in year three.

QUESTION 4: What impact did the project have on high school student interest in sustainable building science technology education and career opportunities?

In year two, the project reached out to 131 high school students through events such as the Tahoma High School Future Ready Day.

Summer Institute

Importantly, the project also conducted a summer teacher institute designed for high school teachers with the goal that they learn about concepts and engage with case-studies, tools, and activities that they could use to build a teaching unit for their students and build high school student interest in sustainable building science classes and careers. The institute, *Supply and Demand—Framing Energy through Sustainable Building Science Technology* was held July 11-15, 2016. Topics included energy use, high performance buildings, and city, state, worldwide impacts. A major outcome of the institute was development of PBL curriculum that was appropriate for their classrooms, that that integrated the learnings from the week.

Participants were high school teachers and community college instructors. To evaluate the effectiveness of the Institute, participants were surveyed before and after completing the program. Pre-and-post-institute surveys contained questions about energy and sustainable building science concepts and careers, self efficacy and participant perceptions of problem based learning as a pedagogical tool. Post-institute surveys also asked participants to provide feedback on impacts and on quality of the institute.

Surveys were both qualitative and quantitative in nature, utilizing Likert scales, multiple choice responses and open-ended questions. Representative comments were selected and are in the report narrative.

Summer Institute: About the Participants

There were a total of eight participants, four from K-12 and four from community colleges. The demographics are below:

- 22.2% Asian
- 44.4% White
- 33.4% Did not respond

- 44.4% Female
- 33.4% Male
- 22.2% Did not respond

Summer Institute: Quality

100% of respondents rated the institute as excellent or good. Participants were asked to rate aspects of the institute such as quality of the speakers, tours, Pre-institute communications, Information usefulness, Content organization, Impact and relevance, , Thursday Mentors, Food and Accommodations. Using a four-point Likert scale, numerical values were assigned as follows:

- Excellent = 4
- Good = 3
- Fair = 2
- Poor = 1

The average rating for all elements was 3.34 out of a possible 4.00. The most highly rated (3.86) was the *Fred Hutchinson Eastlake Tour* and the lowest rating was a tie (3.00) and went to presenters delivery for *Sustainability* and for *Measuring Energy & Portfolio Manager*.

Summer Institute: Knowledge of Building Science

Participants were asked to rate their understanding building science topics and concepts, before and after the institute. Respondents were provided with a series of statements and they self-reported their level of knowledge and understanding using a seven-point scale, with 5 = High and 1 = Low.

The mean ratings were calculated for each statement. The greatest change in knowledge and understanding occurred for the topics of *measurement and diagnosis of building system interactions* and *software that track energy use in buildings*.

Average Responses, Pre and Post Workshop Survey of Knowledge and Understanding			
STATEMENT	n=7 PRE	n=7 POST	% Change
The relationship between energy and sustainable building science technology	1.78	3.86	116.9%
Software that tracks energy use in buildings	1.33	3.29	147.4%
Building science career opportunities and educational pathways	2.00	3.57	78.5%
Building science	1.78	3.57	100.6%
Measurement and diagnosis of building system interactions	1.33	3.57	168.4%

In every case the post-workshop score indicated that self-reported level of knowledge and understanding of topics and concepts related to building science doubled or nearly doubled for participants.

“This was a life-changing experience for me. From Day 1, I was drawn in because I saw relevance for me and my students as well as for the world.”
Participant comment

Summer Institute: Teaching and Learning of Building Science

Participant perceptions of concepts related to teaching and learning of building science were surveyed prior to and at the completion of the institute. Respondents reported their level of agreement with a series of statements, using a five-point Likert scale. Ratings were assigned a numerical value as follows:

- Strongly Agree = 5
- Agree = 4
- Neutral = 3
- Disagree = 2
- Strongly Disagree = 1

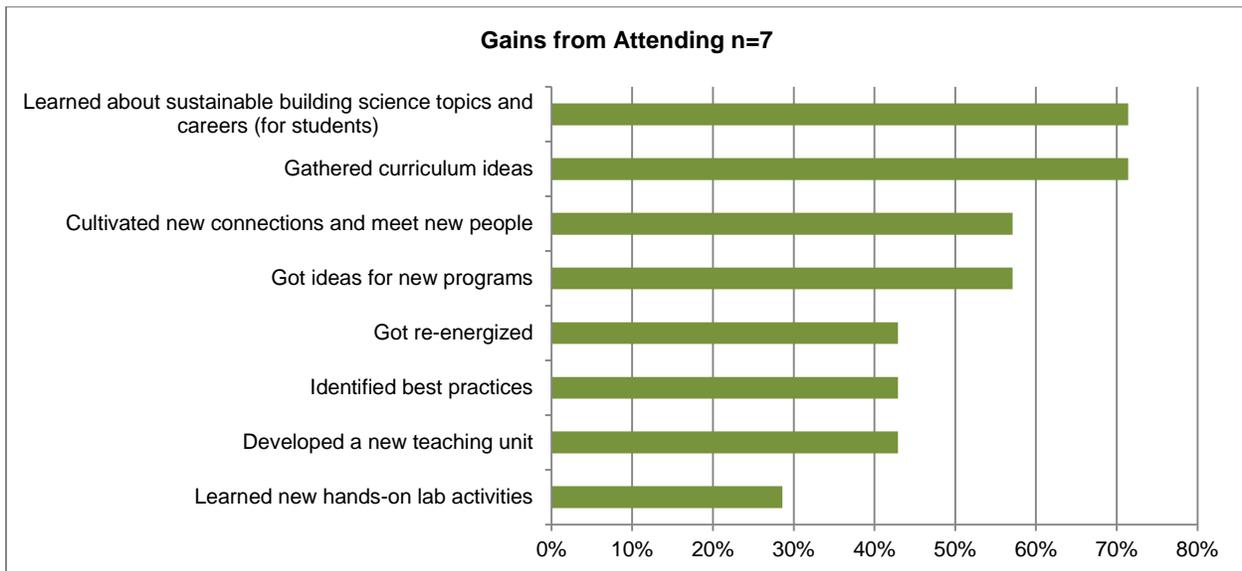
The mean ratings were calculated for each statement and are shown in the table below.

Average Responses, Pre and Post Institute Survey of Perception			
STATEMENT	n=9 PRE	n=7 POST	% Change
Students can learn about energy/building science in a variety of settings and disciplines	4.56	4.71	3.3%
Problem-Based Learning is a useful pedagogical tool	4.78	4.71	-1.5%
Connections to industry are important to students	4.78	4.86	1.7%
“Living Labs” are an effective method of applying class learnings	4.33	4.86	12.2%
I see the connection of building science to societal issues	4.44	4.71	6.1%

A higher score indicates greater agreement with the statement. While the change in attitudes and perceptions was not as large as the increase in knowledge, in all cases but one the post-workshop score indicated a more positive perception building science classroom strategies. The top statements in terms of percentage change in the means (greater than 5% change) are:

- #1. Living labs are an effective method of applying class learnings.
- #2. I see the connection of building science to societal issues.

Respondents also reported on outcomes of their participation in the institute. *Learned about sustainable building science topics and careers* and *Gathered curriculum ideas* were most often cited by participants. They were asked to select the top three gains they accomplished as a result of attending, as shown in the chart below.



Pathways

Each institute participant created a new module that was appropriate for their classrooms. One project developed a 2-week summer course for students at Cleveland High School called *Sustainability in the Built Environment: Energy, Water, Waste*. This course was designed to expose a diverse population of students to SBST concepts and careers and will be offered in late July / early August. Evaluation surveys were designed for the students and data will be available in year three.

CONCLUSIONS AND RECOMMENDATIONS

Based on review of project documentation, observation, interviews with staff and surveys of stakeholders, SBST is making progress toward its goals. The BAS in Sustainable Building Science Technology has had two cohorts of students, and its first cohort graduated in year two of the grant.

Highlights of the SBST accomplishments in year two are below:

- Cohort 1 (15 students) completed the program and Cohort 2 (18 students started the program)
- Conducted its first summer teacher institute with 8 participants rating it highly
- Added 12 new articulation agreements with colleges in the Puget Sound Region
- Completion of the course content, materials, syllabi and websites for the final four courses
- 89% persistence
- 27% women (vs. 4% nationally)
- Built a cohesive and collaborative team
- Strong participation by industry

The project is behind in its metrics for total enrollments and completions and recruitment of veterans. The project worked hard to improve in these areas, and, while the total metrics may not be met, it is anticipated that the enrollments for Cohort 3 will reflect those efforts. Additionally, the new articulation agreements lay the groundwork for a consistent flow of students from community colleges in the region.

PI Holly Moore and the SBST team are to be commended for their flexibility, innovation and persistence and for their commitment to sustainable building science technician education in the region and across the country.

Recommendations

The first recommendation is to continue the high quality work with the workforce and education systems.

It is recommended that the team read all of the open-ended comments from the post-institute surveys. Institute participants had several unique suggestions that would be individually beneficial. Several respondents felt the first day could use some improvement. Overall, the input is valuable for improving future institutes.

As the project enters its final year, it will be important to work with the external evaluator to review and update all aspects of evaluation including the logic model, evaluation and data gathering plans, evaluation methodologies and instruments to ensure that they are maximized to gather the most worthwhile and constructive impact data, including pointers toward impact and rubrics for major benchmarks. In particular, follow-up surveys with students who completed, surveys of industry partners, and follow up surveys of institute participants are recommended.

APPENDIX 1

APPROACH TO EVALUATION

Approach to Evaluation

The evaluation is primarily based on adaption of the Context-Input-Process-Product evaluation model developed by the Evaluation Center at Western Michigan University, under the direction of Arlen Gulickson, PhD and Daniel Stufflebeam PhD. The year's activities were evaluated following Gullickson's four essential elements:

1. The degree to which the project is achieving its goals.
2. The level of impact, and the degree to which the project is reaching intended individuals or groups.
3. The effectiveness of the products and services delivered to constituents.
4. Ways in which the project can be significantly improved.

The investigative approaches recommended by the Evaluation Project at Western Michigan University were utilized to produce a theoretically based, complete and comprehensive review of the Project:

- Objective Orientation: How closely the products and services meet the stated goals and objectives as stated in the grant proposal.
- Teaching/Learning Process Orientation: Based on the perspective of teachers, how the Project activities are assisting or facilitating teaching and learning.
- Customer Orientation: From the perspective of students, how the Project activities are improving learning, comprehension and retention.
- Faculty and Institutional Support: The degree to which the Project efforts are integrated and accepted, and the positive changes resulting from the efforts.
- Business and Industry Support: The level of acceptance and support for the Project efforts by business and industry, especially those which hire graduates and utilize the technician workforce.
- Management: The degree to which processes are in place or under development that leverage the effort with the goal of building on the Project activities, products and services after the funding period comes to an end.

Each item in the evaluation plan was considered from one or more of the approaches listed above. The following methods were used to develop the data necessary to cover the topics in the evaluation plan:

- Interviews with Principal Investigator, Co-Principal Investigators, Project staff, partners and faculty.
- Determination of impacts and influences on technician level education.
- Analysis of documents.
- Analysis of applicable survey and other data gathered to date.

Project data-gathering activities and subsequent data analysis were guided by standards developed by the Joint committee on Educational Standards and Evaluation. All active and passive data gathering activities involving human subjects were approved by the appropriate institutions' IRB (Institutional Review Board).

APPENDIX 2

SUSTAINABLE BUILDING SCIENCE TECHNOLOGY

6 QUARTER DEGREE SEQUENCE

QUARTER 1

BST	301	Building Science	3
SBST	321	Building Codes in Washington State	2
SBST	302	Building Components and Systems	2
SBST	322	Energy Analysis and Auditing	3
		TOTAL CREDITS	10

QUARTER 2

SBST	432	Fiscal Management for Facility Managers	3
SBST	314	Portfolio	2
SBST	333	Building Controls for Energy Efficiency	4
SBST	325	Internship	1
		TOTAL CREDITS	10

QUARTER 3

SBST	422	Facilities Management	4
SBST	401	Utility Rates, Regulation and Economics	2
SBST	402	Lighting	3
SBST	325	Internship	1
		TOTAL CREDITS	10

QUARTER 4

SBST	421	Energy Policy	3
SBST	431	Professional Communication	4
SBST	325	Internship	3
		TOTAL CREDITS	10

QUARTER 5

SBST	331	Financing Energy Efficiency and Renewable Energy	2
SBST	332	Building Energy Codes in Washington State	3
SBST	489	Capstone	1
SBST	325	Internship	4
		TOTAL CREDITS	10

QUARTER 6

SBST	315	Workforce Experience Practicum*	10
		TOTAL CREDITS	10



***credits earned by work experience documentation**

Degree sequence subject to change. South Seattle Community College does not discriminate against individuals on the basis of race, color, creed, national origin, sex, disability, age, religion, honorably discharged veteran or military status, or sexual orientation.