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Incorporating Renewable Energy Resources into Workforce Development for Technical Programs

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Consultancy Project Executive Summary

Organization:	Gardner-Webb University School of Education
Project Title:	Incorporating Renewable Energy Resources into Workforce Development for Technical Programs
Candidate:	Stanley Oswald
Consultancy Coach:	Dr. Jeffrey Hamilton
Defense Date:	July 7, 2017
Authorized by:	Alan Clayton, Midlands Technical College Industrial Technology Department Head

Acknowledgments

"I must not fear. Fear is the mind-killer. Fear is the little-death that brings total obliteration. I will face my fear. I will permit it to pass over me and through me. And when it has gone past I will turn the inner eye to see its path. Where the fear has gone there will be nothing. Only I remain."

Frank Herbert, Dune

I would like to first thank my wife, Alisa W. Oswald, without your assistance this journey would not have begun. Your patience, love, and understanding with me during this time is greatly appreciated.

A large thank you for my mother, Evelyn Sheffield, for you have always told me nothing is beyond my reach; all that I am and all I hope to become, I owe to you.

To my departed Father, Horace B. Oswald; The sleeper has awoken.

Linda Wessinger and the late Harry Wessinger, we all miss you Harry. Your support has been unwavering.

My brothers Russell and Rodney Oswald, your knowledge and insight provided a welcome outlet.

Jessica and Drayton Oswald, all things are possible if you believe in yourself. Live this life, live it abundantly, it is the only one you have.

My classmates, Wendy Dellinger, John Johnson, Kay Ray, Masonya Ruff, and Jack Weller; thank you for letting me laugh, vent, rave, share, and experience this with you.

My peers, Bobby Belcher, Tony Waymyers, Greg Lee, Thom Knight, and Matthew Lester, you let me bounce all kinds of ideas off of you and you added your sincere and honest opinions.

Dr. Hamilton and Dr. Lutz, thank you for your guidance and wisdom. You demonstrate daily the quality of Gardner-Webb University.

Finally, I would like to thank the United States Army, specifically, Colonels Steven Durst (Ret.), Colonel Rick Leonard (Ret.), Colonel Gary Shaffer (Ret.), Colonel Mark Stevens (Ret.), Lieutenant Colonel Kent Weir (Ret.), and so many others that have offered their service, leadership, and guidance over the last three decades. Airborne!

As with most journeys, they eventually end. This has been a journey the likes of which changed the manner, vision, and outlook I had of the world, this experience has caused me to grow, listen, and understand. I undertook this journey not knowing what to expect, looking into blackness, then leapt vigorously into the unknown and that has made all the difference.

Abstract

Incorporating Renewable Energy Resources into Workforce Development for Technical Programs. Oswald, Stanley, 2017, Consultancy Project, Gardner-Webb University, Digital Commons

As renewable energy sources such as photovoltaic and wind turbines are becoming more prevalent in the generation of electrical energy, it is imperative to have a trained workforce familiar with theory, installations, troubleshooting, and maintenance of renewable energy systems. It is this reason an undertaking is in place to develop a program to train individuals in the Fairfield, Lexington, and Richland County areas of South Carolina to provide entry level training in renewable energy solutions. The reason this project was undertaken hinged on several key factors; one of them being the availability of an untapped resource readily available in South Carolina, an abundance of natural sunlight, developing a workforce to install and maintain systems, and the ability to assist households in reducing energy costs. Additionally, in 2014, South Carolina law changed allowing for the ready installation of renewable energy systems. The project consisted of researching other colleges and universities currently offering renewable energy programs.

Amendment History

N/A

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1 Introduction

1.1 *Project Purpose*

The goal of this project is to develop a trained workforce capable of installing solar energy appliances and equipment in the Fairfield, Lexington, and Richland County areas of South Carolina. The purpose is to expand the Industrial Electricity/Electronics program (EEM) to include a certificate in solar training versus the current status quo. Adding the proposed programs will incorporate technological advances in the industry to the EEM curriculum to train the future workforce. This supports the organizational missions of the South Carolina Technical College System and Midlands Technical College of developing students ready to enter the job market, building a workforce, and strengthening the economic development in the midlands area and South Carolina.

1.2 *Associated Documents*

See Appendix

1.3 *Project Plan Maintenance*

The project was changed from the initial milestone from an associate degree to a certificate. This change accomplished the ability to refine the implementation process quicker and allow for a more robust program targeting the area of concern. This change was presented to the Industrial Technology department head; and once in agreement, the change was implemented for action.

2 Project Scope

A change in the manner in which electrical energy can be generated, sold, purchased, and leased by renewable means has occurred in South Carolina. The South Carolina General Assembly passed and the Governor of South Carolina signed into law S.B. 1189 in June of 2014. This law allows for Third party leasing of renewable energy production, photovoltaic (solar) systems, and requires electric utilities providing electrical power to more than 100,000 customers to generate a minimum of 2% electrical energy by 2018. The third-party leasers would be potential employers of Midlands Technical College graduates, potentially installing photovoltaic equipment on dwellings and businesses taking advantage of the net metering portion of ACT 236. This presents opportunities and challenges to the Midlands Technical College Industrial Electricity/Electronics Program to implement and incorporate advanced technology and photovoltaic (solar) systems curriculum to provide to the college's service area. This law will necessitate a trained workforce versed in advanced technology and photovoltaic systems. Currently, only two technical colleges present photovoltaic training: both offer certificate programs and neither is close to the Midlands Technical College service area. Currently, Midlands Technical College Industrial Electricity/Electronics program offers a diploma. The addition of the Renewable Energy Certificate would be comprised of Industrial Electricity/Electronics courses and incorporate building construction classes as well as add three renewable energy classes approved by the South Carolina Technical College System.

2.1 Outline of Partnering Organization's Objectives

2.1.1 Objectives

- The development of the Renewable Energy Program is to develop a workforce in the Fairfield, Lexington, and Richland county areas of South Carolina to provide entry level employees to area employers with a need for installing or maintaining renewable energy systems.
- Midlands Technical College undertook this project due to the natural fit with existing programs and the change in South Carolina law which will increase the demand for a trained entry level workforce.
- The Renewable Energy program incorporates existing programs in the area of career programs which is part of the mission of Midlands Technical College.

2.1.2 Success Criteria

The success criteria by the Industrial Technology Department at Midlands Technical College has been to accept the Renewable Energy Program curriculum in the Fall 2017 offerings at the College.

2.1.3 Risks

Midlands Technical College assumes minimal risk with the addition of only three classes already in the South Carolina Technical College System as the only requirement. The equipment needed can be used by other programs already offered by Midlands Technical College. The Industrial Electricity/Electronics program was already involved in renewable energy technics as they related to the National Electric Code and electrical generation and usage.

2.1.4 Objectives

Goal 1: Select and develop a certificate in solar photovoltaic installation that the college is willing to implement and offer.

Objective 1: Develop justification statement for the College

Objective 2: Justification of the proposed certificate

Objective 3: Curriculum Display Semester-by-Semester (lecture, lab, credit breakdown)

Objective 4: Related Department Support Letters

Objective 5: SBTCE Certificate Notification Form

Objective 6: Needs Analysis

Objective 7: Advisory Board Support

Objective 8: Cost Analysis

Goal 2: Provide Qualified Instructors for the Solar Certificate Program.

Objective 1: Have North American Board of Certified Energy Practitioners (NABCEP) certification.

Objective 2: Have electrical instructors with acceptable certification for electrical installations.

Goal 3: Obtaining classroom, laboratory, and installation area for solar installation certificate.

Objective 1: Obtain area on Midlands Technical College's Airport Campus for instruction.

Objective 2: Establishing a manner to obtain access to the electrical grid for solar photovoltaic systems for operating systems.

Goal 4: Securing needed resources for the solar technician certificate.

Objective 1: Obtain solar photovoltaic systems for instructional purposes

Objective 2: Obtain recurring funding for the solar technician certificate

2.1.5 Success Criteria

The success is the inclusion of a Renewable Energy Certificate with Midlands Technical College and enrolling and enhancing community interest and employment in renewable energy positions in the Fairfield, Lexington, and Richland County areas.

2.1.6 Risks

With concerns to risk, the primary issue with a need to be addressed is the safety of persons and property arising from the use of electricity. These risks are addressed by strict adherence to the most current version of the National Electric Code. Following the prescribed methods of installation will mitigate risk to person and property from the hazards of electricity. Obtaining resources has been addressed by seeking grants and equipment money to purchase the needed materials for implementing the renewable energy curriculum. Additionally, a draft policy has been adopted to address the safety concerns for students and faculty (see Appendix).

2.2 Definitive scope statement

The scope of this project was to research and develop a renewable curriculum, obtain information on renewable technics and practices used in the industry, obtain resources for training, obtain training for the primary instructors, and implement the Renewable Energy Program by Fall of 2017.

3 Deliverables

3.1 *To partnering organization*

See Appendix

3.2 *From student*

See Appendix

4 Project Approach

4.1 Project Lifecycle Processes

The goal of this project is to develop a trained workforce capable of installing renewable energy appliances and equipment in the Fairfield, Lexington, and Richland county areas of South Carolina. While other methods of renewable energy are explored and presented, the rich natural resource of sun in South Carolina are primarily addressed in solar photovoltaic systems for residences and businesses. The purpose is to expand the Industrial Electricity/Electronics program (EEM) to include a certificate in renewable energy training. Adding the programs will incorporate technological advances in the industry to the EEM curriculum to train the future workforce. This supports the organizational missions of the South Carolina Technical College System and Midlands Technical College of developing students ready to enter the job market, building a workforce, and strengthening the economic development in the midlands area and South Carolina.

As technological advances, have taken place in the past decade, the information presented to students in the program has increased. There came a point where classes should be added to address these changes in industry, and now is the time to begin addressing the implementation of additional classes which would expand the college offerings to include a renewable energy certificate program. The South Carolina legislature passed and the Governor of South Carolina signed into law ACT 236, a law allowing leasing of solar energy modules by third parties and requiring utilities providing electrical energy to more than 100,000 customers to produce a minimum of 2% electrical energy provided by 2018. By adding additional classes and retaining the current curriculum, the College, the students, and the local community benefit from the addition of a renewable energy certificate at Midlands Technical College.

The capture of information was made to the advisory board of the Industrial Electricity/Electronics program and by seeking input from professional electrical workers in the midlands area of South Carolina.

The requirements for implementing a new program were those set forth by Midlands Technical College; the systems in place were completed and sent forward through the designed channels for approval.

The faculty in the Industrial Electricity/Electronics program used a Midlands Technical College Foundation grant in the amount of \$2,500.00 to build a portable solar generator to train students and faculty members on the solar energy storage and completion of solar power for use on job sites. The completion of the prototype was June 2015. Currently the prototype is in place and used by faculty and staff for demonstration and job site purposes.

As the program matured in scope, a local vendor provided two wind turbines for energy collection and generation. This action caused a reevaluation to move from strictly photovoltaic to including other methods and means of using renewable energy. While South Carolina has poor wind resources, the gifted wind turbines will be installed and presented as an example of other methods to capture and generate energy.

Inputs to the program were welcomed from the college community. Information was provided by the department head of the Industrial Technology department to other departments in the college at the Academic Affairs monthly meeting.

4.2 Project Management Processes

For the establishment of the Renewable Energy Program, Midlands Technical College has a formal process in place. The process begins with the initiator and ends with the approval of the Curriculum Committee. The formal process is covered in the Appendix.

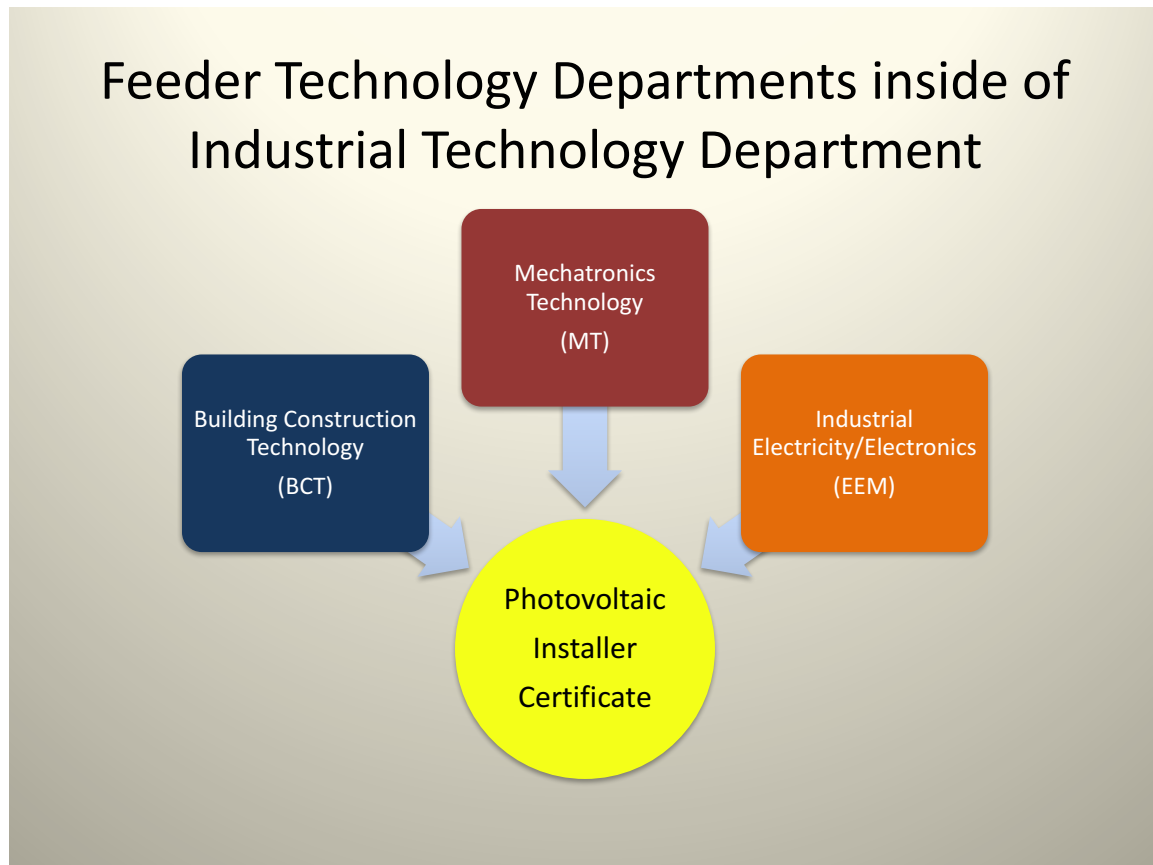
4.3 Project Support Processes

Training at North Carolina State University to obtain an associate level installer certification from the North American Board of Certified Energy Professionals (NABCEP).

Training with local vendors in new applications of renewable energy applications.

Seminars with the South Carolina Solar Council for changes and amendments to the laws pertaining to renewable energy uses and applications for residences and businesses.

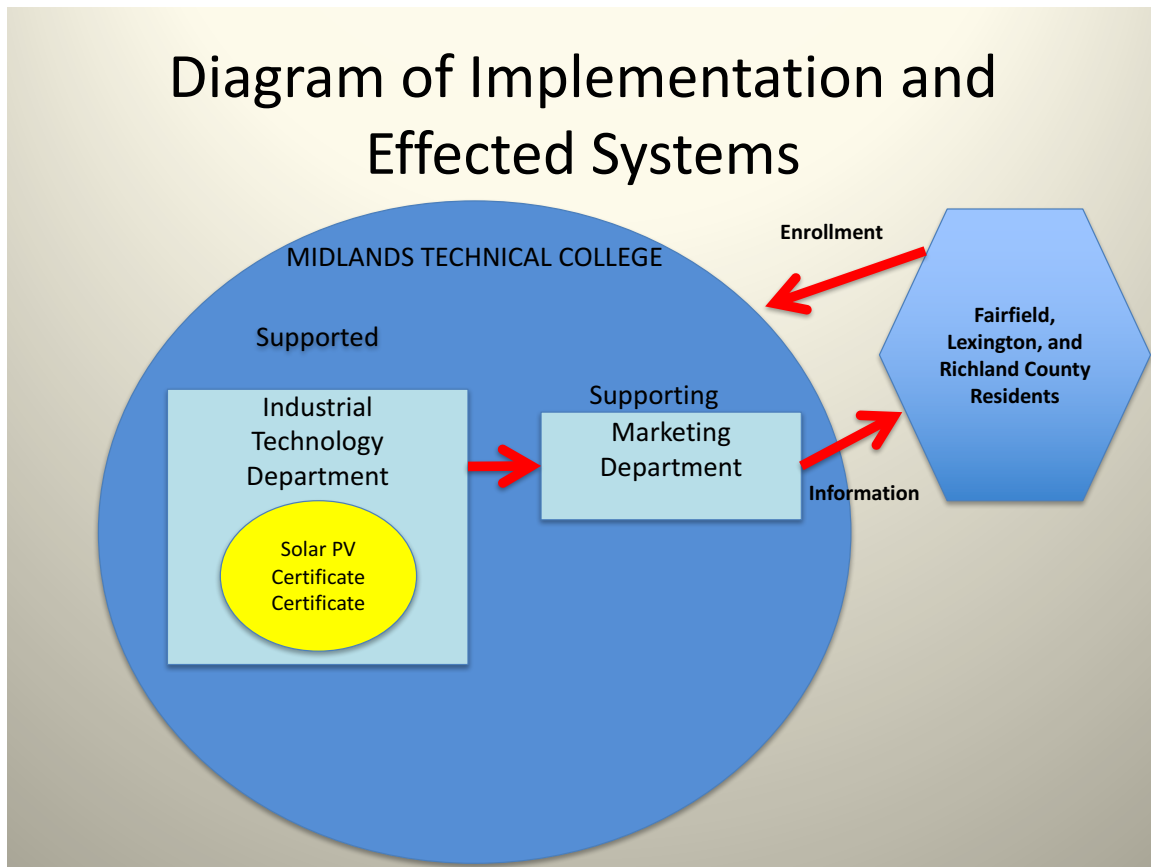
4.4 Organization



4.4.1 Project Team

The project team consists of the technology program coordinators with effected portions of the Renewable Energy Program. Included in this makeup are Industrial Electricity/Electronics, Building Construction, Mechatronics, and Continuing Education. Discussions were with each department to ensure support for the portion of the program in which each technology has involvement. Coordination was done by the department head of Industrial Technology at Midlands Technical College to take portions to higher administration for action and approval. The department head took the proposal to the Vice President of Academic Affairs for initial approval before presentation to the curriculum board for inclusion in the programs offered at Midlands Technical College. Upon approval, Midlands Technical College will offer the Renewable Energy program in Fall of 2017.

4.4.2 Mapping Between Midlands Technical College and Student



5 Communications Plan

Stakeholder	Information needs	Reason needed	Timeline	Manner Received
Midlands Technical College	Substantive Change Monitoring Process Document	Explains the reason for the change	One year before change	See Appendix
	Midlands Technical College SACS/COC Substantive Change Alert Form	Notifies SACS of changes to the colleges offering	One year before change	See Appendix
	MTC CAC Action Form for Course Additions, Deletions and Changes	Additions to the college catalog	One year before change	See Appendix
	Curriculum action packet	To add to the colleges offering in the catalog	One year before change	See Appendix
Local Community	Offerings at the College	Career advancement, personal fulfillment	Continuous	Radio, TV, flyers, billboards, social media.
Midlands Technical College Industrial instructors	Courses offered effecting their areas	Scheduling classes	Semester before offering	Email, phone, personal conversation

6 Work Plan

Securing materials needed for renewable energy generation; acquiring needed space and laboratory area to conduct training. Developing and acquiring tools and classroom resources needed for proper training of renewable energy training. Curriculum development of classes and scheduling. Planning with various departments within Industrial Technology and Midlands Technical College to ensure proper methods were followed to add a certificate program to the college offering.

6.1 Work Breakdown Structure

Goal 1: Select and develop a certificate in solar photovoltaic installation that the college is willing to implement and offer.

Objective 1: Develop justification statement for the College – Completed.

Objective 2: Justification of the proposed certificate – Completed.

Objective 3: Curriculum Display Semester-by-Semester (lecture, lab, credit breakdown) – Completed and attached.

Objective 4: Related Department Support Letters – Completed

Objective 5: SBTCE Certificate Notification Form – Completed

Objective 6: Needs Analysis – Completed

Objective 7: Advisory Board Support – Completed, Advisory Board offered support.

Objective 8: Cost Analysis – Completed and funded; Midlands Technical College has provided needed resources and funding.

Goal 2: Provide Qualified Instructors for the Solar Certificate Program.

Objective 1: Have North American Board of Certified Energy Practitioners (NABCEP) certification – Completed. One full-time instructor is NABCEP Certified as of May 2015.

Objective 2: Have electrical instructors with acceptable certification for electrical installations – Two master electricians are full-time faculty and three adjunct faculty are master electricians.

Goal 3: Obtaining classroom, laboratory, and installation area for solar installation certificate.

Objective 1: Obtain area on Midlands Technical College's Airport Campus for instruction. – Completed. The Renewable Energy Certificate has been provided an area for the installation of a 2 kilowatt ground mounted unit, a 2 kilowatt roof top training unit, an off grid solar house, and 2 kilowatt wind turbines. The area is adjacent to the current Industrial Electricity/Electronics laboratory building and classrooms.

Objective 2: Establishing a manner to obtain access to the electrical grid for solar photovoltaic systems for operating systems.

Coordination with SCE&G for selling as cogeneration is complete. Coordination with the Midlands Technical College Foundation to apply for a metering system permit to allow cogeneration connection is taking place concurrently with the installation of the infrastructure for the Renewable Energy Certificate build.

Goal 4: Securing needed resources for the solar technician certificate.

Objective 1: Obtain solar photovoltaic systems for instructional purposes.

With equipment money provided by the college and donations from the community, Midlands Technical College has secured two complete photovoltaic systems ready for installation; an additional system for AC coupling is in the process of being procured; and two wind generation units have been donated to the college by a local vendor for installation at the Industrial Electricity/Electronics facility.

Objective 2: Obtain recurring funding for the solar technician certificate.

The cost analysis for the "New Certificate Programs" will establish a baseline for funding on a recurring basis if approved by the Academic Affairs Council and the South Carolina Technical College System; additionally, the ability to sell energy to the utility will provide a source of recurring income to the renewable energy program.

6.2 *Resources*

TASK LIST

TASKS	START DATE	DUE DATE	% COMPLETE	NOTES	
Develop Justification statement for the College	9/1/14	8/1/16	100%	Done	
Justification of the proposed certificate	9/1/14	8/1/16	100%	Done	
Curriculum Display Semester-by-Semester	9/1/14	8/1/16	100%	Done	
Related Department Support Letters	9/1/14	8/1/16	100%	Done	
SBTCE Certificate Notification Form	9/1/14	8/1/16	100%	Done	
Needs Analysis	9/1/14	8/1/16	100%	Done	
Advisory Board Support	9/1/14	5/1/17	100%	Done	
Cost Analysis	9/1/14	8/1/16	100%	Done	
Have North American Board of Certified Energy Practioners	7/1/14	9/1/14	100%	Done	Funded by MTC Professional Development
Master Electricians License	8/1/90	8/1/90	100%	Done	
Obtain area	9/1/14	8/1/16	100%	Done	Area identified and allowed by MTC
Access to Electrical Grid	10/1/16	1/1/18	50%		Permits will have to be Drawn by MTC Foundation
Obtain solar photovoltaic systems	9/1/14	1/1/18	90%		Need for disconnects, panels, and conduits
Obtain recurring funding	10/1/16	1/1/18	50%		Recurring funding other than energy production needed

Contact colleges with Renewable energy programs	5/1/15	5/19/16	100%	Done	Victor Valley College, Technical College of the Low Country, Asheville-Buncombe Technical Community, Greenville Technical College
Obtain teaching material from other colleges offering renewable programs	5/1/15	5/19/16	90%		Continuing development for best practices
Dialog with MTC Foundation	9/1/14	Ongoing	90%		MTC Foundation will need to apply for grid connection
Obtain tools and equipment for classroom instruction	9/1/14	Ongoing	90%		Energy measuring meters and battery meters
Develop safety and student policy	9/1/16	12/8/16	100%	Done	

7 Milestones

Milestone number	Title	Forecast date
1	Consultancy Concept and Purpose	05 Dec 2014
2	Consultancy SMART objectives	10 Apr 2015
3	Develop scope, boundaries, and organizations & processes, and systems	10 Apr 2015
4	Develop summary of the business benefits	30 Jul 2015
5	Develop Risk Assessment	10 Dec 2015
6	Summary of facts, assumptions, restrictions and review of SMART objectives	17 Apr 2016
7	Develop outline of project plan	03 Aug 2016
8	Estimate of budget	03 Aug 2016
9	Develop quality assurance plan	10 Dec 2016
10	Track and documentation of overall plan	27 Apr 2017
11	Final Product	07 Jul 2017

8 Metrics and Results

Performance measures used for the renewable energy program were interviews and community outreach to vendors, community members, local high schools, and other colleges with renewable energy programs. The method was through emails, phone calls, and in-person interviews. The reason for the methodology chosen was to gauge the personal opinions and reflections on the use of renewable energy resources and the economic viability of renewable systems in the Midlands Area of South Carolina. A research project was undertaken to meet with users of renewable energy and ask a series of questions. The results were used to reinforce the continuation of the project for the Midlands of South Carolina. Listed below are the results of the interviews and the conclusion.

Question One: What reasons can you present as to your rationale for purchasing a Solar Photovoltaic System?

The two households offered very simple reasons for the installation of a photovoltaic system, the rising cost of energy in the future. Both households were concerned about soon relying on a fixed income since they are planning on retirement in a few years. Household A was concerned the utility they are currently connected to has offered no assurance that rates would not be capped at a certain level; and though it is a cooperative electric utility, the purchase of energy from other sources can rise and are thereby passed on to the consumer. Household B had very similar concerns; however, their concerns arose from the change in policy of the utility to begin charging during peak consumption times which coincides with the peak production of a photovoltaic system, thereby reducing some of the concerns of rising energy costs. The organization had a different approach to the reasoning behind the addition of a photovoltaic system for energy production. The organization is a distributor of electrical products which include solar modules, inverters, and associated material for photovoltaic systems. Since they sell the materials and were encouraging the community to purchase said systems, it was imperative to them to install a system in order to showcase the product they are selling.

Question Two: What is the greatest advantage you have recognized from the installation of the system?

The households both immediately went to cost reduction when asked. One household stated there was a 75% reduction in power usage which translates into considerable monetary outgoing funds and retained income. In addition, one of the contractors also provided other energy savings items to one of the households. The attic of one household was coated in a reflective radiant foil to reduce heat retention in the attic, hence keeping the home cooler during the summer months which requires the air conditioning system to work less thereby saving energy expenditures as well. For the organization, while it has experienced energy savings upwards of 30%, the greatest advantage has been community goodwill and the system acts as an educational tool for future customers as well as local schools and other organizations interested in solar energy practices.

Question Three: What is the greatest disadvantage you have recognized from the installation of the system?

The households commented that the cost of the system was higher than expected but within means. Another issue from the households was the fact that even though they are generating energy, when the power grid is down, they are also out of power. This is a safety feature for utility crews and is understandable. The organization's largest disadvantage was the long-term return on investment. While the system has been installed at the organization for over 2 years, the return on investment is expected to be between 6 and 7 years to recover the cost outlay. The organization mentioned if there was a way to obtain a faster return on investment, there would have been little discussion on the installation; while the organization is aware of the benefit, the existing system will have to be cleared before another will be considered.

Question Four: Are you aware of any contractors that perform photovoltaic installation in South Carolina and would you prefer to use local contractors?

One of the households did intensive research and eventually found a contractor who installed photovoltaic systems in the Lexington/Richland Counties area but is not a South Carolina business but has offices in the Columbia, South Carolina area. The other household expressed the difficulty in finding a reliable contractor for residential applications and decided to seek contractors from the Charlotte, North Carolina and Greenville, South Carolina areas, finally choosing a Greenville, South Carolina contractor for their install. The organization, since their photovoltaic installation was of a commercial industrial level, contacted a large contractor in South Carolina who does large-scale photovoltaic installation; and the contractor is also a customer of the organization as well.

Question Five: Why would you recommend a photovoltaic system to other organizations or individuals?

Both households answered this question in the same manner, stating the overall economic reasons of energy production and cost reduction as the reasons they would recommend photovoltaic systems to others. As they stated earlier, the cost of energy continues to rise; and a photovoltaic system provides a hedge against energy cost increases, especially to fixed-income households. The organization was more detailed in its response, stating that photovoltaic systems reduce emissions and dependence on foreign oil as well as purchasing the energy "up-front" for the next 25 years, as this is the stated warranty on the photovoltaic systems from most major end products. Of course, the organization is concerned about the communities' perceptions of how the organization integrates into the community as a whole.

Question Six: What has been the most challenging issue that has been presented with the installation of a photovoltaic system? (Start to current)

The two households varied on the response to this question; one household mentioned the permitting process with the electrical utility and the difficulty in obtaining required permits in a timely manner. There was a feeling from this household that the utility was intentionally taking their time to prepare and respond to the permitting process. The other household detailed the equipment delivery time since there are limited vendors in South Carolina. Also, the same household commented on the availability of trained installers to perform the installation; and they were on a waiting list for several months before a qualified crew became available for their installation. The organization described the funding process as the most challenging endeavor. The proponent of the system discussed the budgeting process of the organization and how funds had to be set aside for the following year previous to the photovoltaic installation as well as providing information to detractors who were hesitant in funding such a large capital expenditure project when budget dollars are constrained due to the economic environment at the time of the proposed installation.

Question Seven: Are you currently implementing any other renewable or green energy devices?

Both households were using green or renewable methods of energy conservation. Both households used radiant material in their attics and installed more energy efficient light bulbs and appliances. One household owned a Toyota Prius hybrid automobile and mentioned they made the purchase to keep their fuel cost as constant as possible due to the fluctuations in fuel prices. The other household used wood for heating in colder months when the heat pump could not maintain a warm house, and they collected rainwater as well as composting to cut the cost of water and gardening practices. The organization implemented daylight harvesting technology for their offices as well as occupancy sensors to limit the amount of energy cost for unoccupied offices or for the times when sunlight was sufficient for office lighting. Also, the organization has a recycling program and is involved in community activities to promote recycling of metals and other readily recyclable materials.

Question Eight: What amount of energy is your system producing and how much of an offset is that providing to you?

For the households, the energy savings varied due to size and demands. One household's dwelling was approximately 3,500 square feet and their energy savings was 65% from previous energy bills. Accordingly, the system they had installed was 14 kilowatts of nameplate production. The other household described savings of 75% over previous energy bills for their 1,600 square-foot dwelling. The system size was 4 kilowatts. Both savings are significant considering the outlay of monthly income that had been previously earmarked for electric power. These savings are not solely based upon the photovoltaic system but are in conjunction with the other energy saving methods implemented at the time of the photovoltaic systems installation. The organization was experiencing a straightforward 30% reduction in energy costs based solely on the photovoltaic installation as the previously mentioned green energy devices were installed prior to the photovoltaic systems installation.

Question Nine: What was the total cost of the system and what is your anticipated return on investment?

One household which had the larger home, paid \$70,000 USD for their 14-kilowatt photovoltaic system and expects a return on investment of 5 years when including the federal and state incentives offered to the purchase. The other household paid \$35,000 USD for a 4-kilowatt system and with federal and state incentives and is also expecting a 5-year return on investment. The organization paid \$200,000 for their 67-kilowatt system. The organization is halfway through their payback of 6 years as the system was installed 3 years prior to this research project.

Question Ten: How is your system meeting your expectations?

One household stated the system exceeded their expectations in energy savings and reducing the outflow of income for needed electrical energy. Their only issue was not with the system but with the utility as the utility does not pay for additional energy production and only allows for the "banking" of a set level of kilowatt hours; any amount over the predetermined level is "gifted" to the electrical grid. This is the primary reason the household did not consider a larger system. The other household with the 14-kilowatt system was pleased with their system and the savings generated but was disappointed in the manner in which the sales person sold the system, claiming when power was out, the household would have electrical energy. This is possible but not with the type of system that was installed at this location. The organization was ecstatic with the performance of the 67-kilowatt system. If the system had not performed as proposed, the organization would have expended a sizable amount of capital outlay. The history of the system can now be documented, and there are proposals to install other photovoltaic systems at other locations this organization operates.

Conclusion:

While all discussed the desire for maintaining a clean environment, the overall overriding factor was economic. The various green energy or renewable activities pursued by the subjects was to increase the wealth of those implementing the devices or techniques not for the benefit of others. That being stated, the subjects did have a sense of community and fulfillment because what they were doing to save energy was beneficial to those in the community.

Another key point that arose as the project was being conducted was the demographics of the households installing energy producing devices. While not part of this research, the households involved were either retired or planning to retire within the next few years. This means there is more disposable income available, but they are also of the understanding that by purchasing their energy needs before needed, it will allow them to maintain and act as a hedge against increases in energy prices. In the interviews, all parties were well educated on photovoltaic because they had done extensive research prior to making the decision of outlaying the capital required for the systems. They had also determined an estimated return on investment before contacting any contractors to install the system.

The data also demonstrated the potential market that can be developed using early adopters when the economic forces come to a level of critical mass and products are subsidized or prices fall to the point of easy affordability and quantities of the product are available to the market locally. While the customers need an understanding that photovoltaic systems are not systems that are low cost, vendors should present the idea that the consumer is purchasing energy beforehand instead of on demand.

Local high schools that offer electrical or renewable energy programs have expressed an interest in sending students from their programs to study at Midlands Technical College. The community of employers seeking to expand business opportunities have also inquired as to the beginning of the program to enroll employees or seek out potential employees with the entry level skill sets offered at Midlands Technical College.

9 Risks, Constraints, Assumptions

9.1 Risk

Risk Description	Mitigation Plan (what to do to avoid the risk occurring)	Contingency Plan (what to do if the risk occurs)	Impact (what the impact will be to the project if the risk occurs)	Likelihood of occurrence (e.g., %, or high / medium / low)
Death or Serious Injury to Student or Staff while working with Photovoltaic systems.	Ensure electrical safety procedures are followed by Staff and Students. Proper wearing of Personal Protective Equipment (PPE) at all times. Do not work live circuits when possible.	Initiate Emergency management process proscribed by Midlands Technical College Operations.	Very high	LOW
Fire	Proper methods and devices available to address electrical fire.	Initiate Emergency management process proscribed by Midlands Technical College Operations.	Medium to High	LOW
Laboratory safety	Safety programs; Guidelines for Principal faculty; hazardous waste management programs. Constant safety improvements and seminars; Installations in accordance with National Electric Code current edition; Monitoring of student activities	Dependent upon level, Instructors can manage, serious incidents involving medical attention, initiate Emergency management process proscribed by Midlands Technical College Operations.	Medium to Low	LOW

9.2 Constraints

- Usable Land
- Funding
- Community Interest

9.3 Assumptions

- Willingness to pursue by Midlands Technical College
- Qualified Instructors
- Space Available
- Availability of resources
- Community Interest

10 Financial Plan

The financial plan for the development of the Renewable Energy program consists of using the Midlands Technical College Foundation curriculum grants up to \$2,500 for materials to begin the development of the program. As the program development has progressed, end-of-year equipment funding was used and will continue to be sought for further development of the program. The capability of the renewable devices to be grid tied allows for residual income to be recognized for the program through the sale of energy back to the utility at the rates set forth by South Carolina law.

Listed below are the items required at the beginning of the project and the latest status of the cost requirements. Currently, all major material needed to begin the implementation of the program are on hand and ready for installation. There is still the need for some ancillary equipment and tools, but this does not stop the program from beginning on schedule.

Funds from the sale of energy generated to the electric utility will be held by the Midlands Technical College Foundation, the responsible party, to be used as they become available for the maintenance and upkeep of the renewable systems; and any additional funds will be used to provide scholarships to students who qualify for the renewable energy program.

Item	Needed	On hand	Cost
Instructor	1	1	\$0
Solar Modules	28	28	\$0
Micro Inverter	16	16	\$0
String Inverter	2	2	\$0
Ground mount	1	1	\$0
Roof Mount	1	1	\$0
Wind Turbine	2	2	\$0

11 Quality Assurance Plan

Overview of the Quality Assurance Plan for a Renewable Energy Program at Midlands Technical College

Goals, Objectives, Strategies, and Activities are presented

Policies to establish responsibilities of parties involved

Communication plan presented

Included are the primary players in the plan of implementation

Goals	Objective	Strategies	Activities
Provide College level renewable energy instruction	Develop a workforce capable of calculating, designing, installing, and troubleshooting renewable energy systems to an entry-level standard	Target proper community audience for student potential Introduce project management practices Provide the needed courses for the service area	Communicate to the serviced community the availability of renewable energy training Partner with local business, schools, and non-profits
Reduce operational cost	Install a PV system on the AMSC facility	Provide alternate source of revenue	Install renewable energy systems to Co-Generate electrical power
Revenue generation	Provide revenue to Renewable Energy program	Develop policy with the Midlands Technical College Foundation to earmark funds gathered	Use any revenue generated to offset cost of maintenance Any remaining funds to be offered as scholarships
Establish Partnerships	Develop partnerships with MTC operations, South Carolina Energy Office, SCE&G, Vendors, and contractors	Staff and Faculty Counsel, Advisory Board, MTC Leadership, contractual agreements	Present the finding to the College community and leadership to demonstrate viability and self-funding possibilities
Community Goodwill	Develop relationships with local high school building programs, colleges, and needs based organizations	Offer student assistance to nonprofit and educational organizations	Presentations and trade show exhibits to highlight College offerings and abilities
Policy Development	Develop and present workable policies for students, College, and Foundation	Develop policy for working with renewable energy devices and distribution of revenue	Present policy to incoming students, address change in MTC Foundation policy to reflect needs of the program

Appendix

Substantive Change Monitoring Process For Midlands Technical College

I. Overview

Midlands Technical College is accredited by the Commission on Colleges (COC) of the Southern Association of Colleges and Schools (SACS). As part of ongoing accreditation, the COC requires under Comprehensive Standard 3.12 *Responsibility for compliance with the Commission's Substantive change procedures and policy* that "When an accredited institution significantly modifies or expands its scope, changes the nature of its affiliation or its ownership, or merges with another institution, a substantive change review is required." Additionally, the COC defines substantive changes as "a significant modification or expansion of the nature and scope of an accredited institution." To comply with this requirement, Midlands Technical College has established an internal mechanism to ensure that the College is in compliance with the COC requirements.

II. Midlands Technical College's Substantive Change Monitoring Process

A. Identification of Substantive Change

The college must report any substantive change to the COC in a timely manner. Consequently, the college's Executive Council must be aware of the substantive change reporting requirements and include appropriate questions related to this area when plans regarding any new project or change in the academic offerings of the institution are developed.

- The Director of Assessment, Research and Planning serves as the college's Accreditation Liaison. The Accreditation Liaison, through the President, will be responsible for notifying the COC of any substantive change and ensuring notification is completed in a timely manner.
- The Accreditation Liaison will attend an annual meeting of the college's Executive Leadership team to discuss the SACS Substantive Change Policy requirements, to inform the team of any changes in the policy that will impact the college and to update them on issues reported by the college to the COC in the previous year. All members of the Executive Leadership team will be responsible for identifying substantive change issues in their area and contacting the Accreditation Liaison.
- The Accreditation Liaison will attend an annual summer meeting of the leadership team in the Academic Affairs division of the college to discuss the SACS Substantive Change Policy requirements. The conversation will focus on planning related to all curriculum activities including the development and termination of existing courses and programs, program expansions at existing campus locations and all off-campus offerings during the upcoming academic year. Additionally, the Accreditation Liaison will meet in January of each year with the Vice President for Academic Affairs to discuss anticipated curriculum offerings for the upcoming year.
- The Accreditation Liaison will be on the distribution list from the office of the Vice President for Academic Affairs to receive all correspondence regarding

curriculum planning initiatives. The Vice President for Academic Affairs along with the Academic Department Chairs will be responsible for identifying all curriculum issues that may/will require substantive change notification and communicating them to the Accreditation Liaison for reporting to the COC.

- The Accreditation Liaison will annually meet with the Sr. Vice President for Business Affairs and the Director of Operations to discuss the SACS Substantive Change Policy requirements as it relates to college facility planning initiatives.

B. Notification and Compliance Procedure

1. As soon as a potential substantive change is identified, the appropriate Vice President will submit a *Substantive Change Alert Form* to the Accreditation Liaison's office. The form must be reviewed and signed by the appropriate Vice President.
2. The Accreditation Liaison will consult with the appropriate Vice President and the COC Institutional Representative and other appropriate COC staff to determine if the proposed change qualifies as a substantive change.
3. If determined to be a substantive change, the Accreditation Liaison will outline the next steps required to report the change to the COC and coordinate the preparation of all required materials.
4. The Accreditation Liaison will forward the required materials to the COC under signature of the President.
5. **Prospectus:** Preparation of a prospectus will be coordinated by the Accreditation Liaison in consultation with the President and appropriate Vice Presidents. Other members of the college community will be involved in the process based on the content of the substantive change.
6. **Site Visit:** Some types of substantive change will require a site visit. Preparation of a prospectus will be coordinated by the Accreditation Liaison in consultation with the President and appropriate Vice Presidents.

Midlands Technical College SACS/COC Substantive Change Alert Form

This form is used to officially notify the Accreditation Liaison that a potential activity at the college may qualify as a substantive change as defined by the Commission on Colleges of the Southern Association of Colleges and Schools

Name: Stanley B. Oswald Date: 13 June 2016

Title: Program Coordinator
Phone/Ext.: 3201

Description of Potential Change: The purpose of the program of instruction is to train and describe students to enter the workforce with entry level skills in the renewable energy sector. Currently there are no institutions in the Midlands area of South Carolina offering renewable energy classes. The program of instruction will include solar building fundamental, photovoltaic energy generation and installation, and wind generation.

Timeline Proposed for Implementation:

 X Fall 20 17 Spring 20
Summer 20

Location of the Proposed Activity:

☒ Airport Campus ☐ Beltline Campus
☐ Harbison Campus ☐ Northeast Campus
☐ Batesburg/Leesville Campus ☐ Fort Jackson
☐ Other (Please Specify): _____

Substantive Change Category:

 X Initiating New Program(s) Title: Renewable Energy Technician

 Associate Degree

 Diploma

 X Certificate

Describe why this is or is not a significant departure from current programs: This is not a significant change as the courses offered are currently offered at Midlands Technical College. Using EEM, BCT and IMT courses to develop a base and then adding three SOL classes that will primarily concentrate on the solar harvesting of energy. The SOL classes are already in the SC TECH catalog.

 Terminating Existing Program(s)
Title: _____

☐ Associate Degree
☐ Diploma
☐ Certificate

Substantive Change Category (Cont.):

☐ Initiating a Branch Campus

☐ Initiating an Off-Campus Site

☐ Students can obtain 50% or more credits toward program
Program(s)

Impacted: _____

☐ Students can obtain 25-49% or more credits toward program
Program(s)

Impacted: _____

☐ Initiating Distance Learning

☐ Students can obtain 50% or more credits toward program
Program(s)

Impacted: _____

☐ Students can obtain 25-49% or more credits toward program
Program(s)

Impacted: _____

☐ Other (Please Specify):

Approvals:

Department Manager Signature: _____

Date: _____

Assoc. Vice President Signature: _____

Date: _____

Vice President Signature: _____

Date: _____

Please include this form with your curriculum action packet. A response from the SACS Liaison must be received before actions are forwarded to the Faculty Curriculum Committee

**Attachment A
Page 5**

MTC CAC Action Form for Course Additions, Deletions and Changes

Originator: Stanley B. Oswald
/ Department: Industrial Technology
Department Chair Approval:

Program Name

Date of Request:

SUBJECT: Courses to be ADDED/DELETED/CHANGED in the MTC CAC

Please ADD the following course(s) to the MTC CAC:

Course Prefix And Number	Course Title	Action Requested: Add, Delete, Change	CIP Code	Beginning Term	Number of Seats	12 Lecture Credit Hours	Lab Credit Hours	Total Credit Hours	Total Contact Hours	Prerequisite(s)
SOL-101	Solar Building Fundamentals	ADD	150505		8	2.00	1.00	3.00	5.00	EEM 117 & EEM 118, MAT 100
SOL-120	Basic Solar Energy Technology	ADD	150505		8	2.00	1.00	3.00	5.00	EEM 117 & EEM 118
SOL-201	Solar Photovoltaic Systems	ADD	150505		8	2.00	2.00	4.00	8.00	EEM 117& EEM 118

Return completed form to Linda Mims for processing.

Fall 2017

MAJOR: Renewable Energy Technician Certificate

General Education Course Requirements (credit hours)

<u>Lecture Hours</u>	<u>Lab Hours</u>	<u>Credit Hours</u>
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Major Course Requirements (credit hours)

EEM 140 – National Electrical Code	2.0	3.0	3.0
EEM 117 – AC/DC Circuits I	2.0	6.0	4.0
EEM 118 – AC/DC Circuits II	2.0	6.0	4.0
IMT 102 – Industrial Safety	2.0	0.0	2.0
BCT 111 – Blueprint Reading and Specifications	3.0	0.0	3.0
EEM 165 – Residential/Commercial Wiring	3.0	3.0	4.0
SOL 101 – Solar Building Fundamentals	2.0	3.0	3.0
SOL 120 – Basic Solar Energy Technology	2.0	3.0	5.0
SOL 201 – Solar Photovoltaic Systems	2.0	6.0	4.0

Additional Course Requirements (credit hours)

Elective Choices (credit hours)

Total Semester Credit Hours Required:

30.0

Draft Policy Proposal

1) Purpose: The purpose of this policy is to establish the manner the Renewable Energy Program at Midlands Technical College shall be administered in respect to Instructors, Students, Midlands Technical College staff, Midlands Technical College Foundation staff, and third parties.

2) Guidelines: The most current edition of the National Electric Code (NEC) shall be in effect for all installations of solar and wind generators on the property on Midlands Technical College. All pertinent Articles of the NEC shall be adhered with special attention paid to Article 690 of the NEC. The connecting electric utility will provide their methods and procedures

3) Safety: This list includes but is not limited to the proper usage of safety equipment and Personal Protective Equipment (PPE).

A) Instructors' responsibilities: Instructors are responsible for the proper installation and safety of personnel and equipment on the property of Midlands Technical College. Instructors shall ensure all personnel in contact with any equipment are wearing the proper PPE for the activity being undertaken. All Occupational Safety and Health Administration (OSHA) regulations shall be adhered with concerns to falls, energized equipment, and safety procedures. Instructors shall be provided the following PPE and wear them when working on or around renewable energy installations.

1. Safety Glasses
2. Closed toed shoes
3. Long pants
4. Hard Hat
5. Lock out/Tag out kit
6. Gloves with a minimum voltage rating of 500 volts with inserts and covers
7. Proper hand tools for electrical installation

B) Student responsibilities: Students shall be responsible for the purchase and wear of all needed safety equipment from a list provided by instructors of Midlands Technical College. Failure to adhere to safety requirements shall be strictly and quickly corrected. Students who fail to follow safety requirements shall be removed from the area of instruction and not allowed to return to classroom instruction until proper safety measures have been satisfied. No loose clothing or jewelry can be worn when actively participating in laboratory experiments.

The following is a list of student responsible PPE.

1. Safety Glasses
2. Closed toed shoes
3. Long pants
4. Hard Hat
5. Lock out/Tag out kit
6. Gloves with a minimum voltage rating of 500 volts with inserts and covers
7. Proper hand tools for electrical installation

3) Solar Installations: Solar installations present special attention due to the solar module is always energized when light is present. At no time will any person work on an energized solar array while it is connected to the electric utility grid, LOCK OUT AND TAG OUT the solar array system prior to conducting any changes, measurements, or connections to the system to prevent back feed voltage to the system. Only when the Instructor is satisfied all correct connections have been made shall the system be connected to the utility electric grid.

4) Wind Generation installations: At no time shall any person work on an energized wind generator while it is connected to the electric utility grid, LOCK OUT AND TAG OUT the wind generator system prior to conducting any changes, measurements, or connections to the system to prevent back feed voltage to the system. Only when the Instructor is satisfied all correct connections have been made shall the system be connected to the utility electric grid.

5) Instructor Qualifications: A certified North American Board of Certified Energy Professionals (NABCEP) person on site shall only conduct Classes. The Associate level NABCEP certification shall suffice this requirement. The Instructor shall also hold, at a minimum, a recognized electrical Journeyman's License from a recognized certifying organization in the United States of America. No person other than a certified and recognized Midlands Technical College employed instructor shall connect a renewable energy system to the grid once the electric utility has provided the proper permission. At no time shall anyone other than an authorized instructor place a system on line. The connecting electric utility is not required to obtain permissions to disconnect or connect a Midlands Technical College renewable energy system to their grid system.

6) Third Parties: Third parties shall notify the Midlands Technical College staff or faculty should there be a need to interact with the any renewable energy system. This includes but it not limited to vendors, sales personnel, other educational institutions, or non-electrical utility grid persons. The Midlands Technical College Foundation may at any time perform tours with prior coordination with the Renewable Energy Program, Industrial Electricity/Electronics Program, or the Industrial Technology Department.