

Energizing Tomorrow's Workforce: Creating a Pathway to Electrical Utility Careers

Project Description

Results from Prior NSF Support

No prior support from NSF.

Introduction

Richmond Community College is seeking a *Small Grant for Institutions New to the ATE Program* to enhance its capacity to train technicians for the electric utility industry. The goal of the project is to increase enrollment in academic programs that prepare students for work in the electric utility industry in order to bridge the gap between employer demand for qualified workers and students with the skills to match employment opportunities. The goal will be achieved through implementation of four strategies: (1) create career and technical pathways for high school students to earn dual credit, (2) provide industry-related professional development for RCC instructors who teach high school students, (3) equip the career and technical classrooms at an area high school with up-to-date technology for hands-on learning, and (4) enhance marketing and recruiting efforts to increase awareness of career opportunities in the electric utility industry and the RCC programs that will prepare students for those careers.

Through enhanced marketing and recruiting efforts targeting middle and high school students and those likely to influence their career choice--parents, teachers, and counselors--RCC will increase the number and quality of students who pursue energy-related degrees, and thereby address the workforce needs in this high-wage, high-demand industry. Providing students with access to the latest technology for hands-on learning will equip students with the skills necessary for entry level positions in the field. Professional development opportunities will ensure that RCC faculty have the knowledge and skill to prepare students for careers in the industry. The career and technical pathways will accelerate completion of college certificates, diplomas, and associate degrees that provide entry-level job skills.

RCC serves a two-county area, Richmond and Scotland counties. RCC's campus is located in Richmond County and the College and Richmond County Senior High School have partnered to provide busses to bring RCSH students to the RCC campus for career and technical classes.

Motivating Rationale

The rationale for the proposed project is based on industry demand and a gap analysis that identified the strengths and weaknesses of RCC's academic programs in meeting the needs of its industry partners. RCC relies heavily on its industry partners to identify workforce needs as well as helping to identify gaps in education and training. Data was collected over the past year through annual advisory committee meetings, employer surveys, employer evaluations of interns and workforce development training, national and state level employment reports, and annual program and student learning assessments. Analysis of this data identified three primary gaps that support the need for this project: unmet industry need, too few students with adequate math preparation enrolling in engineering technologies programs, and limited awareness of potential careers.

1. Unmet industry need for highly skilled technicians

Presidential Policy Directive 21 (PPD-21): Critical Infrastructure Security and Resilience identified the energy sector as 1 of 16 critical infrastructure sectors, describing the energy sector as “uniquely critical due to the enabling function [it] provide[s] across all critical infrastructure. A 2013 survey conducted by the Center for Energy Workforce Development (CEWD) revealed that almost half of the skilled technicians in this critical industry may need to be replaced in the next ten years. The CEWD projected that, between 2012 and 2022, North Carolina utility companies will lose 2,630 employees due to retirement and attrition (CEWD, 2013). Field workers, including technicians, are among the job categories in greatest demand. A 2014 report from Manpower projected that energy jobs will double by 2020, yet a “double squeeze” of an aging workforce and lack of qualified candidates contribute to talent shortages for the industry (Manpower, 2014). Moreover, 58 percent of energy executives responding to ManpowerGroup’s survey reported that their company “struggles to find the talent it needs” and 74 percent believe the problem will get worse in the next five years. Of particular concern are students with inadequate preparation in STEM and rapidly changing technology. A large majority (86%) of energy executives agreed that today’s energy workforce requires a more complex skill set than it did five years ago and 90% indicated that today’s workers require higher levels of technical competency.

RCC’s Electric Utility Substation and Relay Technology (EUSRT) program was developed in 2011 in partnership with Duke Energy to train high voltage electric utility substation and relay technicians and to reduce training from a 4-year degree and 5 years of on-the-job training to a 2-year degree and less than 3 years of on-the-job training. The program has grown dramatically in large part due to RCC’s expanding industry partners (including Duke Energy, SPX, Dominion Power, and North American Substation Services). Industry partners provided guidance on curriculum and instruction as well as donations of equipment to support training. According to Caren Anders, Senior Vice President and Chief Transmission Officer for Duke Energy, RCC’s “focused program allows students to graduate in two to three years...typical training regimens can take five years to complete. Richmond Community College’s accelerated program allows Duke Energy and the industry to hire graduates and fill demand for this critical work at a faster pace.” Yet, the program graduates far too few students to meet industry need. RCC’s industry partners have specifically identified needs for relay technicians, substation technicians, and instrumentation and controls technicians. Table 1 shows the projected hires for 2015 from four of RCC’s industry partners.

Company	Projected Hires
Duke Energy	20
Dominion Power	22
North American Substation Services	40
SPX	2
TOTAL	84

Over the past three years, a total of 16 students graduated from the EURST program. All of these students are currently employed in the electric utility industry.

2. Too few students enrolling in engineering technologies programs and too few students with adequate preparation in math

Over the past three years, enrollment in the EUSRT program and demand from employers has grown substantially. The EUSRT program enrolled 19 students during the first semester, Fall 2011. By Fall 2014, enrollment had grown to 74, an increase of 395%. The EUSRT program has been successful in placing graduates in high-wage jobs in the industry. Yet, the demand for graduates is much greater than the supply, and that demand reaches beyond the state. RCC regularly receives requests for graduates from companies across the Southeast. Additionally, the EURST program does not address the industry need for accelerated preparation of highly skilled workers for jobs other than relay and substation technicians, jobs such as instrumentation and controls technician, industrial engineering technicians, electricians, power plant operators, and installers.

RCC is working to broaden the scope of focused training by replicating the EURST success for multiple pathways leading to a variety of careers in the electrical utility industry. In addition to growing enrollments in the EUSRT program, RCC is expanding its training of technicians for the electric utility industry to include an industry focus in five additional degree programs: Computer Engineering Technology, Electronics Engineering Technology, Electrical Systems Technology, Industrial Systems Technology, and Mechatronics Technology (new in 2014). Enhancements to these programs will address specific industry needs including data communications, networking systems, renewable energy, electrical power production, and SCADA (Supervisory Control and Data Acquisition) systems.

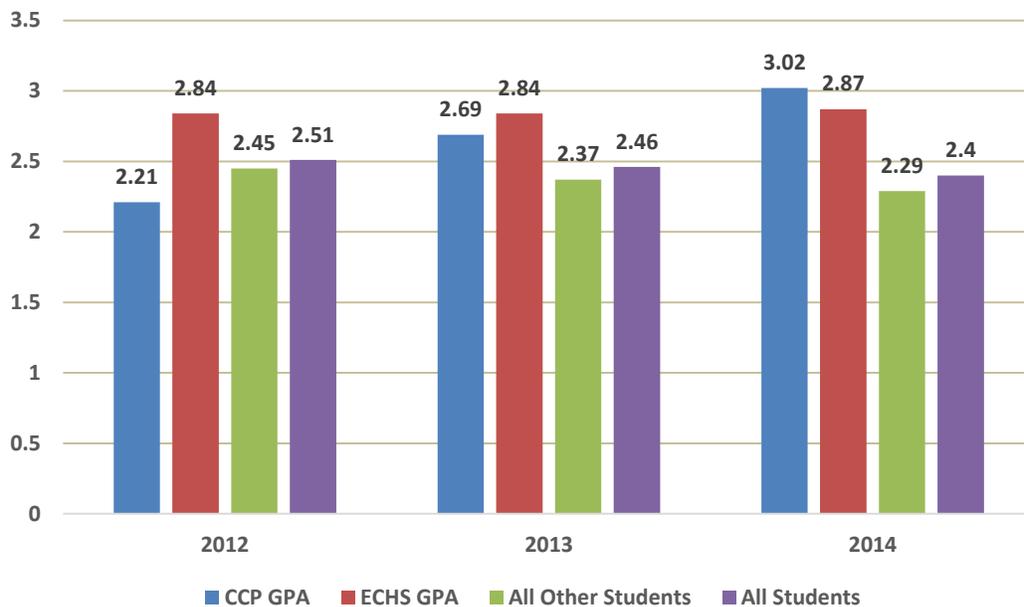
While enrollments in these programs have grown slightly, the supply of highly-skilled graduates is far from meeting the workforce needs of the industry. To meet this need, it is essential to also address persistence rates (graduation/retention).

Program	Year	Enrollment	Graduation Rate	Retention Rate	Graduation/Retention Rate
Computer Engineering Technology	2013-2014	42	5%	38%	43%
	2012-2013	34	9%	56%	65%
	2011-2012	38	5%	58%	63%
Electric Utility Substation and Relay Technology	2013-2014	77	13%	48%	61%
	2012-2013	53	9%	55%	64%
	2011-2012	19	5%	53%	58%
Electronics Engineering Technology	2013-2014	22	14%	59%	73%
	2012-2013	22	23%	45%	68%
	2011-2012	28	11%	50%	61%
Electrical Systems Technology	2013-2014	22	27%	23%	50%
	2012-2013	25	12%	36%	48%
	2011-2012	30	10%	27%	37%
Industrial Systems Technology	2013-2014	38	18%	34%	53%
	2012-2013	29	17%	45%	62%
	2011-2012	38	29%	34%	63%

*The Graduation Rate is the percentage of total students enrolled in a program who graduated from the program between September and August of that academic year. The Retention Rate is the percentage of students in a program who did not graduate but returned to any curriculum program in the following Fall semester.

Many students struggle to complete a degree program due to lack of adequate academic preparation, particularly in math. Each year, approximately one-third of students entering engineering technology programs are required to take developmental math. In 2012-2013, only 63.8 percent of RCC developmental math students successfully complete a credit math course with a “C” or better upon the first attempt (NCCCS, 2014). Across the country, colleges have turned to dual enrollment to increase enrollment and persistence among students who lack sufficient preparation for college. There is a growing body of research demonstrating that dual enrollment is correlated with higher graduation rates, higher college enrollment and higher levels of persistence (CCRC, 2012; Rodriguez et al, 2012). Career and technical pathways emphasizing relevant and engaging instruction can motivate students to stay in high school and later enroll in college. Realizing that career and technical programs allow them to obtain competencies and credentials that will help prepare them for a career can be a motivating factor as well. Career-focused dual enrollment programs have also been shown to improve academic and non-academic skills, understanding of college expectations and to increase employment and earnings, particularly for low-income students (Karp, 2006; Rodriguez, et al, 2012). In addition, dual enrollment can decrease the cost of college by providing no-cost college credit and decreasing time to completion of a college degree. Data from RCC’s Career and College Promise program supports these findings. In 2013-2014, RCC Career and College Promise (includes college transfer and career and technical dual enrollment programs) students earned higher GPAs in college courses than other RCC students, including Early College High School (ECHS) students.

Figure 1: Scotland County CCP GPA Compared to Other Student Populations



This project is based on the premise that by increasing enrollment of high school students in dual enrollment pathways (CCP CTE), RCC can increase enrollment in engineering technologies programs, increase the percentage of students entering those programs

academically prepared, increase persistence rates in those programs, and thereby better meet industry demand for qualified technicians.

3. Limited awareness of potential careers in the electric utility industry

Research shows that the high school years are a critical period for students and their career decisions (Subotnik et al, 2010). In 2010, the Business High Education Forum (BHEF) described a “system dynamics model of the U.S. STEM Education system” developed by the Raytheon Company that recognized that to increase student enrollment in STEM majors, students must be both proficient and interested in STEM (BHEF, 2010). Students are often deterred from pursuing STEM degrees because of perceived deficiencies in math. Research by Kesici and Erodogan (2009) suggests that students’ anxiety about math can affect perceptions about their abilities and achievement in math courses. Perceptions also appear to play a role in the STEM gender gap. Knezek et al (2001) found that the STEM gender gap is related more to a gap in perceptions of STEM careers than to ability.

Student perceptions, particularly among populations underrepresented in STEM must be considered in attempts to increase diversity in STEM degree programs. Ruggs et al (2012) examined the research on a number of different strategies for increasing diversity in STEM fields and found the following to be effective:

- Providing role models and diverse examples. Role models and diverse examples can include female or minority teachers in STEM classrooms or outreach programs, as mentors, speakers, or in recruitment advertising.
- Involving students in active learning. Incorporating hands-on activities that provide students opportunities to apply knowledge has been shown to be beneficial for students who may not have otherwise been encouraged to explore a STEM field.
- Reframing education topics and tasks. Research has shown that girls are more interested in careers in which they can help people. Framing STEM disciplines in ways that are interesting to girls will likely increase their interest. For example, framing careers in the electric utility industry as working to protect the nation’s power grid to provide energy to hospitals, industry, and homes.
- Create safe spaces. Examples of safe spaces include outreach-education programs such as summer camps that emphasize a particular field. Outreach education programs are particularly beneficial for filling in knowledge gaps for students who have not taken advanced-level math and science courses. Outreach programs can also educate parents on possible career options, the training required for those careers, and the costs of education.

Many students come to RCC with little to no career direction or understanding of the programs offered by the College and the careers paths that those programs make possible. This project is based on the premise that through increased awareness and understanding of the career possibilities in the electric utility industry and the educational requirements to enter those fields, more students will enter RCC’s career and technical pathways and will be more likely to enroll in and complete AAS degree programs.

Goals and Objectives

The overarching goal of the project is to increase the number of technicians who are well-prepared for entry-level positions in the electric utility and related industries. The project’s

objectives are as follows.

Objective 1: Increase the number of high school students enrolled in RCC's Career and College Promise Career and Technical (CCP CTE) pathways.

Objective 2: Increase the number of CCP CTE students who enroll in RCC's engineering technologies programs upon graduation from high school.

Objective 3: Increase the percentage of students who enter RCC's energy-related engineering technologies programs adequately prepared in math.

Objective 4: Increase awareness of career opportunities in the electric utility and related industries.

The project will achieve these objectives through implementation of the following four strategies:

Strategy 1: Develop Career and Technical Pathways to careers in the electric utility industry

Career and College Promise provides tuition free dual enrollment career and technical courses for North Carolina high school students. The pathways are created by are community colleges and are taught by community college instructors. RCC will create two new Career and College Promise Career and Technical (CCP CTE) pathways to provide are high school students with opportunities to earn up to one year of tuition free college credit that will prepare them for further education and/or careers in the electric utility industry.

In addition to the EURST program, RCC is in the process of enhancing five engineering technologies Associate in Applied Science (AAS) degree programs to include energy-related courses in order to prepare students for a broader range of careers in the electric utility industry. These five programs will be grouped into two engineering technologies tracks: engineering track (Computer Engineering Technology, Electric Utility Substation and Relay Technology, Electronics Engineering Technology, and Mechatronics Technology) and industrial track (Electrical Systems Technology and Industrial Systems Technology). RCC also has an articulation agreement with Scotland County Schools to provide a pathway for students who have successfully completed the National Center for Construction Education and Research (NCCER) Electrical Level I and Level II certification to transition to the Electrical Systems Technology AAS degree program. To expand the pathways available to area high school students, this project will create a CCP CTE engineering pathway and a CCP CTE industrial pathway to mirror the engineering and industrial tracks.

The enhancement of the engineering technologies degree programs also includes the creation of a platform of common courses that make up the first year of coursework for students in these programs. This platform of courses will provide the basis for the CCP CTE pathways. One course common to both pathways will be EGR110, Introduction to Engineering. This course will emphasize career assessment, professional ethics, critical thinking and problem solving, using college resources, and using tools for engineering computations. Students will learn about possible career paths associated with engineering technologies and the education requirements necessary to prepare for those careers. In addition, CCP CTE students will have the opportunity to earn the same credentials as first year RCC students enrolled in engineering

technologies programs. The credentials include the National Career Readiness Certificate the Energy Industry Fundamentals Certificate.

The CCP CTE pathways will incorporate the following components identified by the Building Engineering and Science Talent (BEST), a public-private partnership, as components of programs with positive outcomes:

- Challenging content: “Content is related to real-world applications; students understand the link between the content they study and career opportunities later in life.” Creating positive experiences such as projects or activities focused on authentic real-world situations can have a positive influence on students’ perceptions and achievement. Career and technical pathways provide opportunities to incorporate contextualized learning opportunities focused on applying concepts to workplace situations.
- Defined outcomes and assessment: Assessment tools are designed to measure outcomes and provide both quantitative and qualitative information, a basis for research, and continuous program improvement. RCC’s annual assessment process include program level assessment of student learning outcomes and plans for continuous improvement. Student data from CCP courses are included in that process.
- Sustained commitment and community support: Continuity of funding, stakeholders are involved and provide support at multiple levels. RCC’s industry partners have demonstrated committed to the success these programs through their engagement and support.
- Engaged adults: Adults who believe in the potential of students stimulate interest and create expectations. Educators play multiple roles and active family support is sought. A number of the activities outlined in Strategy 4 focus on engaging adults.
- Personalization of approach: Student-centered teaching and learning methods are core approaches. Mentoring and peer interaction are important parts of the learning environment. Personalization of learning have long been characteristics of the RCC educational experience and will continue and be enhanced through this project.

Strategy 2: Provide equipment for CCP CTE classes taught at Scotland High School

Scotland High School (SHS) is one of two high schools in RCC’s service area. Through a partnership with Richmond County Schools, Richmond County high school students are provided bus transportation to RCC for Career and College Promise (CCP) classes. To facilitate access to CCP CTE classes for Scotland County students, Scotland County High School has devoted an entire building on its campus to Richmond Community College where RCC instructors will teach CCP CTE courses. This project will equip one classroom with motor control trainers and test equipment to support instruction for ELC112 DC/AC Electricity (Industrial Technologies Pathway), ELC117 Motors and Controls (Industrial Technologies Pathway), and ELC131 DC/AC Circuit Analysis (Engineering Technologies Pathway). RCC currently has four trainers at SHS. However, these trainers are old and are missing components, making it difficult for students to complete essential tasks.

The motor control trainers will allow students to gain hands-on experience with real world applications. The trainer includes industrial standard components that provide learners with real world experience in installation and control of industrial motors and help students build both knowledge and skills across topics like manual motor control, control ladder logic, motor starters, and automatic input devices.

Strategy 3: Expand Professional Development Opportunities for RCC instructors

To ensure that RCC instructors have up-to-date knowledge about the electric utility industry, including the latest technology and employer needs and expectations, instructors will be provided with opportunities to attend four conferences over the three years of the project. These events will provide RCC faculty with opportunities to interact with industry professionals and to learn about the latest industry practices, technology, and education and training needs:

- Georgia Tech Protective Relaying Conference, Atlanta GA: For power system experts and professionals, the conference emphasizes operational practice and the application of new techniques and devices.
- Doble Engineering Conference, Boston MA: The conference brings together peers in the power industry to discuss the pressing topics concerning the industry. Attendees learn and discuss ways to optimize operations and maximize performance to ensure the reliable flow of power. The agenda for the technical presentations is designed exclusively by and for the benefit of the electric utility, testing and industrial company delegates.
- Dominion Resources Power Grid Seminar, Richmond VA: This seminar brings together the education partners of Dominion Power to discuss the company's education and training needs and is by invitation only.
- Institute of Electrical and Electronics Engineers Power and Energy (IEEE PES) Transmission and Distribution Conference, Dallas TX: At this conference, instructors will have the opportunity to network with professionals from across the United States, including from the top 20 utility companies. They will also have opportunities to participate in technical tours of various industrial facilities and to experience real world applications and hands-on demonstrations of the latest technology from conference exhibitors.

Strategy 4: Enhance Career Awareness Activities

The following activities will emphasize career opportunities in the electric utility and related industries. Each activity will target all potential students in the service area, but will include specific features focusing on the recruitment of populations underrepresented in STEM programs including females, racial and ethnic minorities, disadvantaged, middle-achieving, and first-generation students.

- Open houses for parents and students: RCC will hold an annual Open House at the Forte Building (where the engineering technologies programs are housed) and the adjacent electric utility substation and relay lab to introduce students, parents and other interested community members to the engineering technologies programs offered at RCC, the possible career paths available for students completing degrees in those fields, and the skills associated with occupations in those fields. Attendees will also see demonstrations of the equipment used in the programs and hear how that equipment is used in various careers.
- Saturday Academy for school counselors: RCC will hold a Saturday Academy for Richmond and Scotland County middle and high school counselors. Participants will learn about RCC's engineering technologies programs, RCC's Career and Promise Pathways for high school students, academic preparation required for success in these programs, and possible career options for graduates of those programs. The Academy will take place in the Forte Building which houses the engineering technologies programs, allowing for participants to see and experience the hands-on components of the programs. Instructors from nine engineering technologies programs (Computer

Engineering Technologies, Electrical Engineering Technologies, Electrical Systems Technology, Electrical Utility Substation and Relay Technology, Industrial Systems Technology, Computer-Integrated Machining, Mechatronics Technology, Mechanical Engineering, and Welding Technology) will conduct short information sessions about their program. This academy will provide counselors with the information necessary to help students think about possible career paths and to help them make decisions about appropriate high school courses to prepare them for college and career.

- Summer camp for high school students: For the past two years, RCC has operated the Energy Venture Summer Camp for middle schools students. This project will develop an additional, more advanced camp, the High Voltage Summer Energy Camp targeting past participants of the Energy Venture Summer Camp and other rising 9th and 10th graders. The goal of the High Voltage camp is to engage students in fun, hands-on, content-based activities that will help to develop their subject knowledge and awareness of careers in STEM fields. The camp will take place on RCC's campus and will include field trips. In addition, participants in the high school camp will have the opportunity to serve as counselors for the Energy Venture camp.
- School visits: While RCC staff regularly visit area high schools to promote the College, RCC recruiters will expand these visits beyond traditional college and career fairs to include classroom visits to promote careers as well as academic programs offered by RCC. RCC staff will visit a variety of classrooms to discuss careers and academic programs, but particular attention will be paid to higher level math and science classes to target higher achieving students for enrollment in engineering technologies CCP pathways.
- Field trips: Students in CCP classes and the summer camp will participate in field trips to power plants in the region. Possible trips include the Carolina Power and Light Richmond Plant near Rockingham NC, the Harris Nuclear Plant near New Hill NC, the Virgil C. Summer Nuclear Generating Station near Jenkinsville SC.
- Industry Professionals: Industry professionals, including graduates of RCC engineering technology programs, will visit CCP CTE classes and the summer camps to talk with students about their experiences in the electric utility industry including the need for math and science in utility careers and the pay range and job security associated with utility careers. RCC will work to include diversity in its representation of industry professionals to provide role models for all students participating in these activities.
- Enhanced marketing: RCC has found that face-to-face marketing through school visits, summer camps, and visits by industry professionals are the most effective marketing of programs and careers. However, marketing materials such as direct mailings, billboards, social media, etc. are also important means of increasing awareness of academic programs and career opportunities. This project will enhance its current marketing efforts to include more targeted advertising of engineering technology programs that emphasize the career opportunities a degree in one of these programs provides. These materials will focus on selling the career, not the program. Career information will be posted to social media, on digital monitors positioned in the high schools and around RCC's main campus, and included in more traditional print media. Scotland High School has a majority minority student population, however, students in engineering and technology CCP courses are predominantly white and male. To encourage more underrepresented groups to enroll in CCP engineering and technology courses, RCC will develop marketing materials targeting those groups. A female graduate of the EUSRT program has been featured prominently in RCC advertising as an attempt to show female students that careers in the electric utility industry are not just

for males. RCC will continue to develop marketing materials include the representation of underrepresented populations.

The strategies outlined above are focused on increasing the number of high school students who enroll in CCP CTE pathways by increasing the awareness of students, parents, teachers, and counselors about careers in the electric utility and related industries and increasing their awareness of the educational requirements for those careers.

Project Plan

Because of the rigor (particularly in math) of programs designed to meet the technical requirements of careers in the industry, this project focuses on targeted recruitment of students enrolled in high level high school math and science courses and embedded career coaching to Activities include equipping classrooms at Scotland County High School with up-to-date equipment, providing training for RCC faculty who teach relevant classes at SCHS, curriculum development, developing a summer energy camp for high school students and outreach to middle and high school students and their families. Through these activities, the project aims to improve the capacity of the College to address the workforce needs of the electric utility industry. The logic model shown in Figure 2 depicts the premise upon which this project is based, that increasing student, parent, teacher, and counselor awareness of careers in the electric utility industry, increasing their understanding of the educational requirements of those careers, providing dual enrollment opportunities for high school students, and providing education and training based on industry standards and needs should lead to an increasing number of students enrolling in engineering technology AAS degree programs who will eventually seek employment in the electric utility industry.

Figure 2: Logic Model

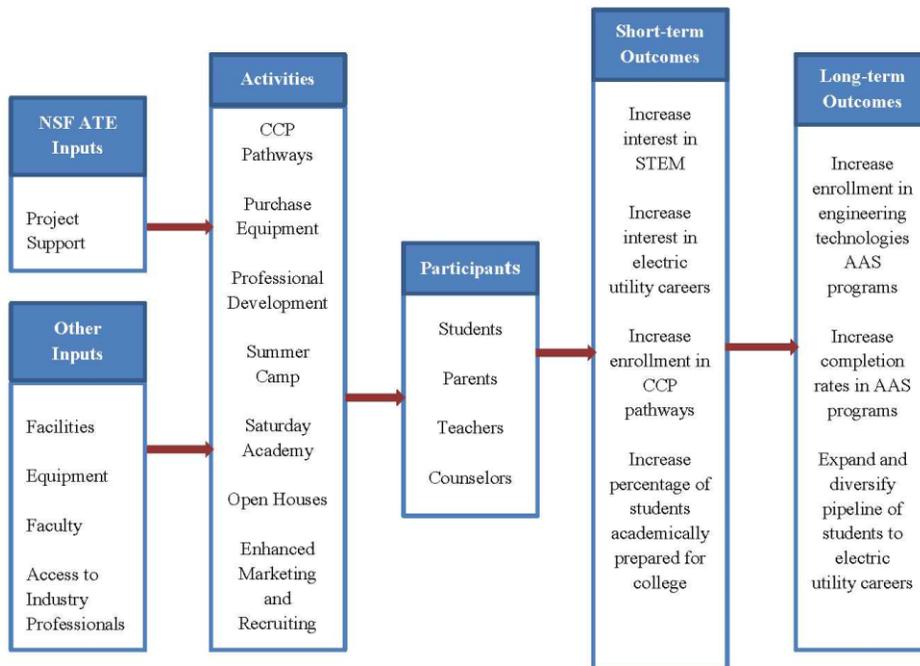


Table 3: Project Implementation Timeline

Activity	Timeframe	Responsible Individual
Purchase equipment for Scotland County High School CCP CTE classes	Summer 2015	Amir Niczad, Dept Chair Engineering Technologies
Develop Engineering and Industrial CCP CTE Pathways	Summer 2015	Amir Niczad, Dept Chair Engineering Technologies
Develop high school summer camp	Summer 2015	Steve Lampley, Instructor Electric Utility Substation and Relay Technology
Develop Marketing Products	Fall 2015	Andy Cagle, Director of Marketing & Communications
Begin offering EGR110, ELC112, ELC117 & ELC131 at Scotland High School	Fall 2015	Amir Niczad, Dept Chair Engineering Technologies and Kary Edmondson, Director of K-12 Partnerships
Field Trip (CCP)	Spring 2016	Amir Niczad, Dept Chair Engineering Technologies and Andy Cagle, Director of Marketing & Communications
Open House	March 2016	Amir Niczad, Dept Chair Engineering Technologies and Andy Cagle, Director of Marketing & Communications
International Conference of Doble Clients	April 2016	Amir Niczad, Dept Chair Engineering Technologies
IEEE PES Transmission and Distribution Conference	April 2106	Amir Niczad, Dept Chair Engineering Technologies
Georgia Tech Protective Relaying Conference	May 2016	Amir Niczad, Dept Chair Engineering Technologies
Dominion Resources Power Grid Seminar	June 2017	Amir Niczad, Dept Chair Engineering Technologies
Saturday Academy	Summer 2016	Amir Niczad, Dept Chair Engineering Technologies and Kary Edmondson, Director of K-12 Partnerships
High School Summer Camp	Summer 2016	Amir Niczad, Dept Chair Engineering Technologies
Field Trip (CCP)	Spring 2017	Amir Niczad, Dept Chair Engineering Technologies and Andy Cagle, Director of Marketing & Communications
Open House	March 2017	Amir Niczad, Dept Chair Engineering Technologies and Andy Cagle, Director of Marketing & Communications
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Dominion Resources Power Grid Seminar	June 2017	Amir Niczad, Dept Chair Engineering Technologies
High School Summer Camp	Summer 2017	Amir Niczad, Dept Chair Engineering Technologies
School Visits	On-going	Andy Cagle, Director of Marketing & Communications

Deliverables

The primary deliverables for this project include the Career and Technical Pathways, the week-long High Voltage Summer Energy Camp for high school students, and the Saturday Academy for school counselors. Articulated course sequences and course outlines will be developed for two Career and College Promise Career and Technical pathways (engineering technology pathway and industrial technology pathway). The camp activities will be developed by RCC faculty from the Electric Utility Substation and Relay Technology program. The camp will build on the currently offered energy camp for middle school students. In addition, Engineering Technologies instructors, in coordination with the Director of Marketing and Communications will develop materials for use in the Saturday Academy.

Intellectual Merit

The project aims to serve as a national model for providing a skilled workforce in a high-wage, high-demand industry, specifically through recruiting high school students to enroll in dual credit courses related to the electric utility industry and providing the students, their parents, teachers, and counselors with information about the high-wage career options available to students who complete an Associate in Applied Science Degree in an energy-related discipline.

The project will leverage the innovative and proven strategies learned from RCC's Electric Utility Substation and Relay Technology (EUSRT) program to create career and technical pathways for high school students to multiple careers in the electrical utility and related industries. The pathways are based on successful models and will focus on introducing high school students to potential career opportunities in the electric utility industry and provide training on the latest technology used in the field. The pathways will facilitate accelerated entry into these lucrative and critical jobs by allowing students to earn up to one year of college credit while in high school. The professional development provided for faculty is based on the premise that faculty who teach career and technical courses are better able to adequately prepare students for work if they are regularly exposed to industry trends and challenges. Enhanced marketing and recruitment efforts will include middle as well as high school students, parents, teachers, and school counselors to increase community awareness of careers in the industry.

Broader Impact

While the focus of the project is the electric utility industry, the marketing and recruiting efforts will serve to increase public awareness of STEM careers in general. The project will include activities focused on increasing the number of underrepresented populations, including women and minorities, in RCC's energy-related engineering technologies programs. By increasing awareness and opportunities for high school students to earn college credit, this project will increase the likelihood that area high school students will attend college and graduate. In addition, institutions interested in any of the strategies address through this project will have access to findings and materials produced through this project through a variety of venues, including the ATE Central website, conference presentations, and RCC's website.

Project Management Plan

Roles of Key Personnel

Table 4: Key Project Personnel and Roles	
Key Personnel	Roles
Amir Niczad, Department Chair, Engineering Technologies, Richmond Community College	Principal Investigator: <ul style="list-style-type: none"> Oversee project activities, sustainability efforts, and reporting Coordinate budget management with College finance office
Kary Edmondson, Director of K-12 Partnerships, Richmond Community College	Senior Personnel: <ul style="list-style-type: none"> Facilitate development and implementation of CCP CTE pathways Coordinate with Scotland and Richmond County schools on Saturday Academy
Andy Cagle, Director of Marketing, Richmond Community College	Senior Personnel <ul style="list-style-type: none"> Oversee development of marketing and recruiting materials Facilitate recruitment for summer camp Coordinate activities associated with the Open House
Steve Lampley, Lead Instructor, Electric Utility Substation and Relay Technology, Richmond Community College	Senior Personnel: <ul style="list-style-type: none"> Oversee development and implementation of energy summer camp
Jose D'Arruda, Professor of Physics, University of North Carolina at Pembroke	Evaluator <ul style="list-style-type: none"> Conduct external evaluation to include analysis of both process and outcomes data

Sustainability Plan

The majority of the grant funds will be used for the creation of the engineering and industrial pathways, the development of the energy summer camp, and recruitment of high school students into the pathways. Creation of the pathways and summer camp activities is a one-time expense. Ongoing expenses include recruitment and professional development. Greater student participation increases FTE (full-time equivalent) for the College. FTE is primary determinant of state funding for North Carolina's community colleges. As FTE increases, more funds are available to support programs. Therefore, the program will be sustained primarily through increased enrollments that generate higher FTE. For additional expenses, such as replacing outdated equipment, the College works with the Richmond Community College Foundation to raise funds and/or obtain grant funds. The College has a strong history of fundraising and successful grants management. Recently, the College expanded, renovated, and equipped the Forte Building, housing high-tech STEM programs, with a \$2M grant from the Economic Development Administration. an additional \$875,000 raised by the Foundation through private grants and donations, and equipment donated by industry partners.

Evaluation Plan

Dr. Jose D'Arruda, from the University of North Carolina Pembroke, will conduct a rigorous evaluation of the project. The purpose of this evaluation is twofold: 1) to assess the

implementation of the project for continuous improvement, and 2) to determine the outcomes and corresponding impact of the project activities.

The evaluation will be both formative (process-oriented) and summative (outcome-oriented) and will contribute to the annual and final project reports to be submitted to the National Science Foundation. The annual report will be used to inform the program's continuous improvement efforts and the final report will be produced by the external evaluator and submitted at the end of the evaluation period.

Year 1 of the evaluation process will focus on establishing data collection protocols and agreements and monitoring implementation. In Year 2, the focus will be on continuing to monitor implementation and gathering outcome data. Year 3 will focus on continuing to gather outcome data and assess the impact of the project.

Project Outcomes

The following table provides an overview of the analysis plan by outcome measure and data source. The evaluator will work with the Director of Institutional Research to develop a project database to house all data pertaining participant outcomes.

Outcome Measure	Data Source
1. Enrollment of high school students in new CCP CTE engineering and industrial pathways (total, gender, race/ethnicity)	Datatel
2. Total number of high school students completing credit hours in CCP CTE pathways	Datatel
3. Total number of high school students earning credentials	Datatel
4. Total number of students enrolled in RCC engineering technologies AAS programs after high school graduation	Datatel
5. Student proficiency on identified student learning outcomes	Assessment Documents
6. Student interest in STEM programs and careers	Student Survey

Program Implementation

The implementation evaluation involves gathering data on progress and implementation of program strategies proposed in the project narrative by assessing processes, tools, and supporting materials. The primary goal of this implementation evaluation is to measure progress on the implementation of project activities and to measure how well the proposed strategies contribute to the goals of the project. Twice annual meetings will focus on the project's progress through review of project milestones and deliverables as well as the collected data to assess the strengths and weaknesses of the project. These meetings will result in recommendations for continuous improvement will be included in annual and final reports. The following table provides an overview of the research questions and data sources by that will guide the analysis.

Table 6: Program Implementation Analysis by Strategy	
Evaluation Questions	Data Source(s)
Development of CCP pathways	
How were the pathways developed?	Interviews with PI and Director of K-12 Partnerships; pathway documents
What courses are included in the pathways and what certificates are available to CCP students?	
Equipment for Scotland County High School	
What equipment was purchased for SCHS?	Interviews with PI and program faculty; purchase orders
Which CCP courses and pathways use the equipment?	
Professional Development for Instructors	
What professional development opportunities are provided for RCC engineering technologies instructors?	Interviews with PI and program faculty, conference materials
What benefits did instructors gain through participation in professional development activities?	Interviews with PI and program faculty
How do instructors share what they learned through professional development to others at the College?	Interviews with PI and program faculty
Marketing and Recruiting	
What are the attributes of program and camp activities (type, length, frequency, kinds of learning experiences, etc.)	Interviews with faculty and review of camp materials
What marketing and recruiting strategies were implemented that focused on CCP pathways and electric utility industry?	Interviews with Director of Marketing and Communications and review of marketing materials
What is the target population for each strategy?	Interviews with Director of Marketing and Communications and review of marketing materials

Dissemination Plan

The products and information gained through this project will be disseminated through a variety of formats, both formal and informal. Specific products developed through this project will be made available through traditional formats such as reports, presentations, press releases, websites and social media. Dissemination of project results will also be disseminated more informally through direct contact with students during school visits and summer camps and with parents at the annual Open House.

Table 7: Dissemination Plan	
Project Product	Method of Dissemination
Program/Course Descriptions	College website, school system website
Energy Summer Camp	College website, press releases, social media, print media
Marketing and Recruiting Materials	College website, press releases, social media, print media
Photographs of Facilities	College website, press releases, social media, print media
Evidence of program/student success	Press releases, presentations at state and national conferences, CEWD website
Industry Impact (employment data)	Press releases, social media, presentations at state and national conferences