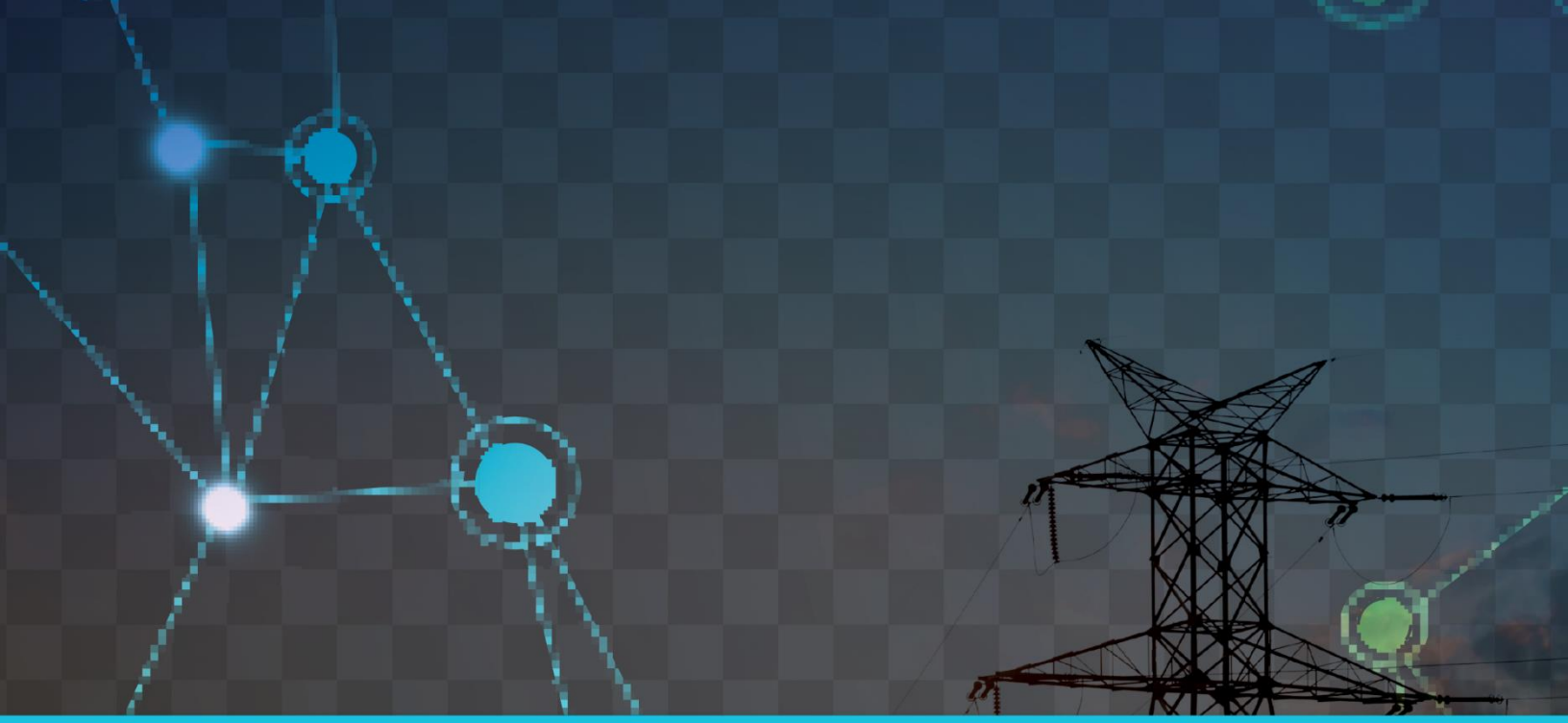


WORKFORCE TRAINING FOR THE ELECTRIC POWER SECTOR:
PROGRAM SUMMARY REPORT

Department of Energy
Office of Electricity Delivery and Energy Reliability
National Energy Technology Laboratory, Energy Delivery Technologies Division

October 2016

U.S. DEPARTMENT OF ENERGY | OFFICE OF ELECTRICITY DELIVERY & ENERGY RELIABILITY

The U.S. Department of Energy would like to acknowledge and thank all of the program recipients who carried out the projects under the Workforce Training for the Electric Power Sector Program. The information gained from the project results, final reports, feedback and lessons learned provided by these recipients was used for this report.

OVERVIEW

A modern electricity grid is vital to the Nation's security, economy and modern way of life, providing the foundation for essential services that Americans rely on every day. The Nation's power grid, however, is aging. The electricity system of the future must continue to evolve and adapt. The mission of the Department of Energy's Office of Electricity Delivery and Energy Reliability (OE) is to lead national efforts to modernize the electricity delivery system, enhance the security and reliability of America's energy infrastructure, and facilitate recovery from disruptions to the energy supply.

The American Recovery and Reinvestment Act of 2009 (Recovery Act), which was an unprecedented action to stimulate the economy, invested $4.5 billion for electricity delivery and energy reliability modernization efforts in the electric sector to jump start modernization of America's aging energy infrastructure to provide more reliable power. The Recovery Act funding has allowed the utility industry to accelerate its investments in grid modernization; helped strengthen the capabilities for long-term analysis and planning in the three interconnections serving the lower 48 United States; provided assistance that will allow States to hire new staff and retrain existing employees to ensure they have the capacity to quickly and effectively review proposed electricity projects; supported the development of interoperability standards and framework; enabled 47 states, Washington DC and 43 cities to develop energy assurance plans for natural disasters; and provided energy restoration training to over 600 local government and utility workers.

Recovery Act funding has also been used to address another need that is critical to modernizing the Nation's power grid: preparing the next generation of workers in the utility and electrical manufacturing industries. Prior to the Recovery Act, research had identified a growing gap in the electricity industry's workforce. The Department of Energy's August 2006 report to Congress entitled "Workforce Trends in the Electric Utility Industry" found that "The percentage of the lineworker workforce expected to retire within the next five to ten years could approach 50% in some organizations. The loss of institutional knowledge is a critical concern, especially for a profession heavily dependent on mentoring and on the job training." The "Workforce Trends in the Electric Utility Industry" report also noted that "University-based power engineering education programs are essential to the supply of power engineering graduates to meet future needs. Yet, the restructuring of the electric utility industry, along with wider interest in newer electrical engineering fields such as microelectronics, computers, and communications, have eroded support for power engineering programs and associated long-term strategic research. In addition, recent data shows a decline in the number of power engineering faculty, exacerbating the problem."

Recognizing the importance of addressing the predicted workforce gap, Congress mandated the creation of a smart grid workforce training program "… to facilitate the development of a well-trained, highly skilled electric power sector workforce, which is vital to implementing a national clean-energy smart grid." Via American Recovery and Reinvestment Act (ARRA) Funding Opportunity Announcement (FOA) 152, OE awarded approximately $100 million under the Workforce Training for the Electric Power Sector Program (WFT) to a mix of universities, community colleges, technical training programs,

industry groups, manufacturers, and electric utilities across the U.S. to create and enhance new and existing training programs and curricula.

The recipients represented a cross-section of the workforce pipeline and supported a broad swath of regional initiatives to prepare people for technician, staff, and engineering positions in the electricity generation, transmission, and distribution industries. Technology areas included energy efficiency and renewable energy, including wind and solar power, as well as energy storage. The intent was to help ensure a well-trained workforce for the grid of the future, provide opportunities for higher compensation for technicians and displaced workers, and assist with economic recovery in depressed communities or regions. In addition, increasing investment in advanced laboratory equipment, faculty development, and academic research ultimately was expected to lead to an increased awareness of issues facing the U.S. electric utility sector such as cybersecurity. To achieve the Program's goals and objectives, projects were awarded in the following three program areas.

DEVELOPING AND ENHANCING WORKFORCE TRAINING PROGRAMS (TOPIC A) – 21 PROJECTS TOTALING $13,756,289

Universities, community colleges and technical schools created training programs to address the entire electricity delivery system, including transmission, distribution, and electrical equipment manufacturing. The programs were designed to serve as models for training/retraining workers across the county.

STRATEGIC TRAINING AND EDUCATION IN POWER SYSTEMS (STEPS) – 11 PROJECTS TOTALING $27,346,317

Universities, community colleges and technical schools developed and implemented new cross-disciplinary electric power system curricula that cover a broad range of smart grid-related topics, including building, operating, and maintaining a modern electricity system, integrating renewable energy sources, and addressing environmental and security concerns. Courses include power electronics, information and communications technologies, policy, and economics.

SMART GRID WORKFORCE TRAINING PROJECTS (TOPIC B) – 17 PROJECTS TOTALING $52,552,741

Utilities conducted training programs for new hires (i.e. displaced workers, military veterans) and retraining programs for electric utility workers and electrical equipment manufacturers to enhance their knowledge of Smart Grid technologies and implementation. Students included power-sector personnel working on smart grid projects.

Projects were awarded throughout the U.S., and with a diverse, representative cross-section of electrical utilities, electrical manufacturers, and academia. A total of 52 projects received awards. Of those, three projects were discontinued at the request of the recipients. A summary of the 49 projects that were completed appears below.

Table 1: Summary of Initial and Final Award Values

		INITIAL			FINAL	
Program Area	**Number of Awards**	**Total Award Value**	**Total Federal Share**	**Total Recipient Share**	**Total Federal Share**	**Total Recipient Share**
Developing and Enhancing Workforce Training Programs (Topic A)	21	$18,229,422	$13,756,289	$4,473,133	$13,161,925	$5,049,674
Strategic Training and Education in Power Systems (STEPS)	11	$36,477,192	$27,346,317	$9,130,875	$26,075,606	$9,199,396
Smart Grid Workforce Training Projects (Topic B)	17	$126,466,774	$52,552,741	$73,914,033	$45,122,104	$57,165,834
TOTALS	**49**	**$181,173,388**	**$93,655,347**	**$87,518,041**	**$84,359,635**	**$71,414,904**

Note: The projects awarded under the Workforce Training for the Electric Power Sector Program varied in value from $87,210 to $5,000,000 (Federal funds). All Federal funding necessary to complete the projects was obligated at the time of initial award. However, during the course of the program some award values were modified due to project changes resulting in the award values decreasing. Additionally, some projects were completed as originally planned but under budget. All unused Federal funds were de-obligated from the awards and returned to the U.S. Treasury.

SUCCESSES

The Workforce Training for the Electric Power Sector Program enrolled and trained significantly more students than originally anticipated. In doing so, the Program raised more awareness nationwide of career opportunities in the power sector, helped displaced workers get back on their feet, retrained veterans for positions in the electric utility industry, and fostered and promoted strong relationships between academia and industry that are expected to be sustained.

FIGURE 1: PLANNED VS. ACTUAL ENROLLMENTS

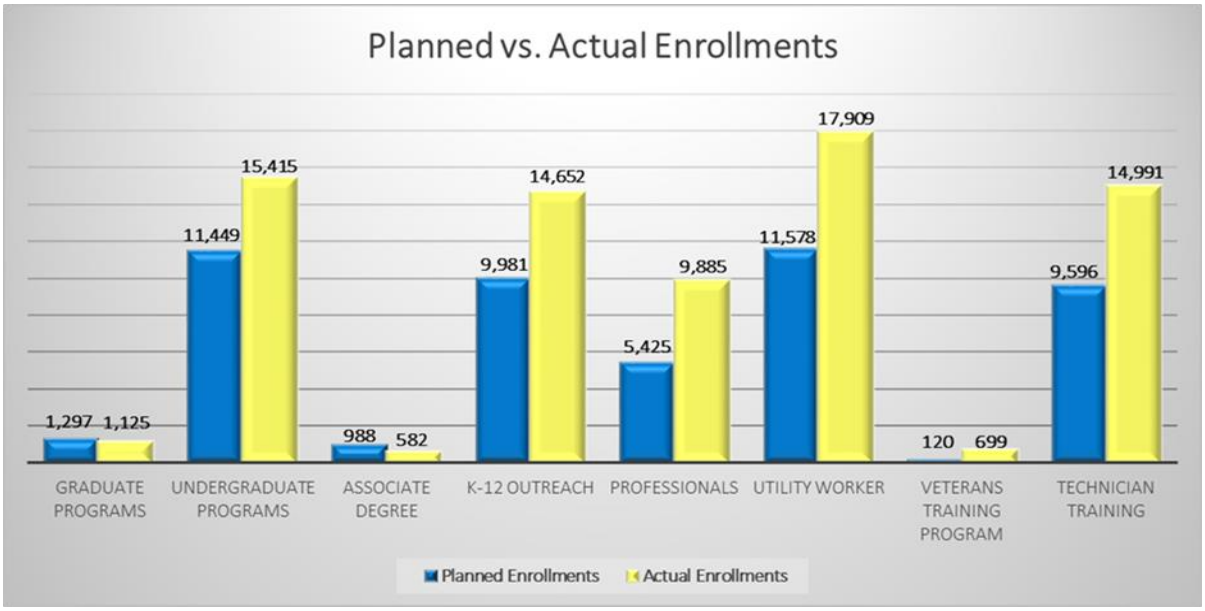
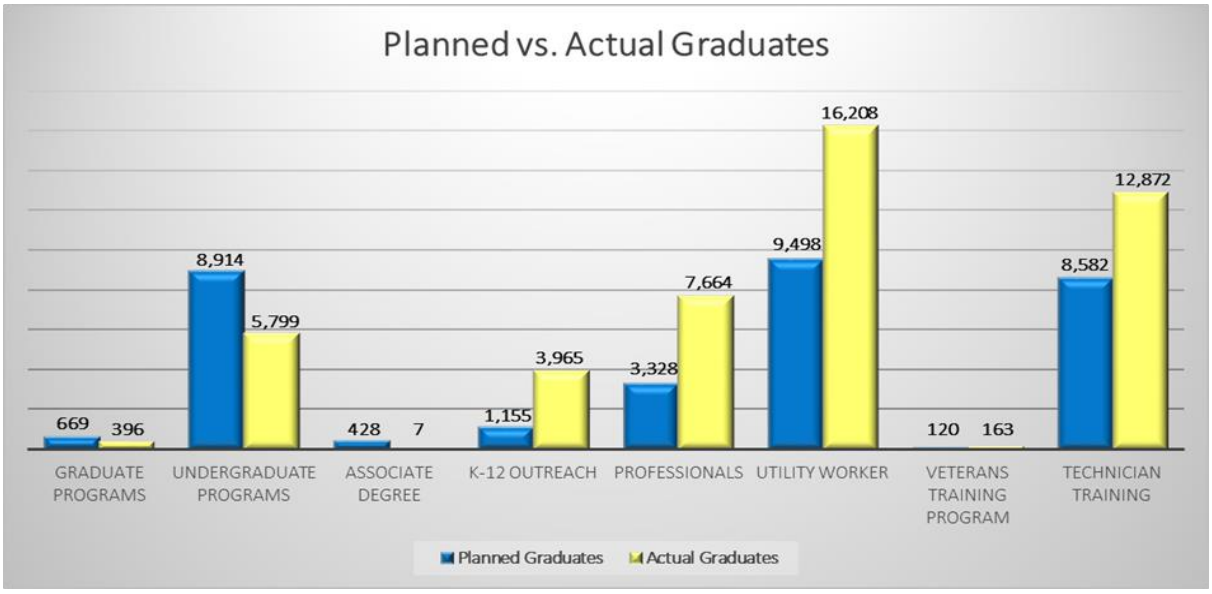


FIGURE 2: PLANNED VS. ACTUAL GRADUATES



Of the approximately 47,000 future technicians, engineers and managers for the power industry trained in the Program, the training classification of "Utility Worker" had the highest cumulative number of graduates (16,208), resulting in 34.5 percent of the total cumulative number of graduates. Also during this time, the DOE developed a comprehensive understanding of the U.S. electric utility workforce, its requirements and the role of both academia and the private sector in meeting those long-term needs.

TABLE 2: Classifications of Training Programs

CATEGORY	DEFINITION
Graduate Programs	Development/delivery of specific courses/curricula at the graduate level
Undergraduate Programs	Development/delivery of specific courses/curricula at the undergraduate level
Associate Degree	Development/delivery of training programs targeted for individuals in (typically) two-year associate degree programs
K-12 Outreach	Development/delivery of curricula, etc., for awareness education of K-12 students and K-12 teachers
Professionals*	Training/retraining of individuals already employed in the utility industry
Utility Worker	Individuals currently employed by utilities that are receiving training from that utility to perform a specific task
Veterans Training Program*	Programs specifically targeted to training/retraining returning veterans
Technician Training*	Individuals in specialized trades or utility workers that require retraining to support the utility/Smart Grid industries

*Includes awarding of certificates, credentials, etc.

Early work focused on developing curricula and delivering critically needed technician training. The program was designed to increase awareness of careers in the electric utility industry over the next decade, as well support other Science, Technology, Engineering and Mathematics (STEM) initiatives by establishing a pipeline, beginning with K-12 and continuing through undergraduate, graduate, and other industry and private-sector training initiatives. A key success was that recipients developed community and regional infrastructure that could provide long-term sustainability, and these awards will evolve into a national network that will continue to renew the pool of engineers, scientists and technicians needed to meet the needs for a trained utility workforce.

Over approximately 75,000 individuals, in eight different classifications of training, benefited or advanced from curricula, training or graduated from a program. This represents a 48 percent increase from the originally planned 50,779 individuals to benefit from this program.

FINAL FINANCIAL STATUS

TABLE 3: SUMMARY OF COMPLETED PROJECTS AND FUNDING

Number of Projects	Total Federal Share: **Initial**	Total Federal Share: **Final (Actual)**	Total Recipient Share: **Initial**	Total Recipient Share: **Final (Actual)**
49	$93,655,347	$84,359,635	$87,518,041	$71,414,904

LESSONS LEARNED AS REPORTED BY THE RECIPIENTS

Recipients identified a number of themes, including (1) fostering and sustaining strong relationships with industry, academia and other organizations such as unions; (2) the value of providing online and "hybrid" (combination of online and traditional teaching/training) to students; (3) the need to cover numerous smart grid-related topics and then be willing and able to update the curricula frequently to keep up with changes in the technologies; and (4) the importance of financial aid in attracting and retaining students.

There were also other lessons learned that the recipients reported. For example, development of a governing board with a wide cross-section of stakeholders was critical to the visibility and success of some of the projects. Institutional investment of staff, management and resources, including investment from the stakeholders to demonstrate support, was necessary for long-term sustainability. Effective outreach programs are crucial for increasing awareness of the Workforce Training Program initiatives, exchanging lessons learned and expanding stakeholders. In addition, some of the recipients reported that successful workforce training programs require collaborative partnerships between public-and private-sector organizations, to ensure the education and training programs are closely responsive to industry needs. More details about the individual recipients' experiences are available in Appendix 2 which provides fact sheets, including metrics, on each recipient. Below are examples of lessons learned provided by recipients.

(1) Fostering and sustaining strong relationships with industry, academia and other organizations is crucial to success.

- (Project OE0000450) Council for Adult Experiential Learning (CAEL) manages the Energy Providers Coalition for Education (EPCE), which is an established, employer-driven coalition, founded in 2000. EPCE's strong relationships between its industry grant partners provided the opportunity to leverage the well-established industry education curriculum co-development process, thus validating the relevancy of the courses for the industry. CAEL stated "A diverse and representative curriculum committee that is intensively engaged in the process of sharing content and identifying subject matter experts from their own organizations ensures that the

content is high quality, rigorous and meets the current and changing needs of the industry. The payoff for this kind of commitment to collaboratively developing curriculum cannot be overstated."

- (Project OE0000484) Mississippi Gulf Coast Community College strengthened relationships with industry partners and academia by helping educators prepare their students for a place in the electric power industry. Mississippi Gulf Coast Community College (MGC) offered curriculum development training to seven of its faculty members (three more than originally planned). In addition, MGC hosted Smart Grid seminars that attracted 246 post-secondary and secondary instructors, more than double the expected attendance. The seminars focused on developing a workforce equipped to interact with Smart Grid technologies and alternative energy sources.

- (Project OE0000464) Pratt Community College used a collaborative partnership with a vendor of software and equipment used by its industry partner (and most other companies within the industry) to develop simulation software for training students. This resulted in students being trained in methods and systems used by the potential employers.

(2) There is value in providing online and "hybrid" (combination of online and traditional teaching/training) courses to students.

- (Project OE0000484) Mississippi Gulf Coast Community College implemented online/hybrid courses. Using this method, MGC developed six courses on the Smart Grid and emerging technologies. MGC integrated the courses into three energy programs: Process Operation Technology, Instrumentation, and Apprentice Lineman Training. MCG also installed nearly $450,000 of Smart Grid technologies and simulation equipment in its labs. As a result, MCG was able to educate a wide variety of students. There were 176 graduates as an Incumbent Worker, 51 graduates in the Apprentice Lineman Training and 198 graduates from the Energy Grant Programs. Still others, who were already employed as linemen, upgraded their knowledge of the Smart Grid and earned continuing education units.

- (Project OE0000457) Salt Lake Community College (SLCC) transformed an outdated, correspondence course for lineworkers, metering and substation apprentices into a contemporary curriculum that is consistent with industry standards and codes, and is now delivered using hybrid, distance and classroom learning. Using this approach, 950 students received at least one industry certification—far surpassing SLCC's original certification goal.

- (Project OE0000463) National Electrical Manufacturers Association (NEMA), in collaboration with George Mason University, Northern Virginia Community College, and member manufacturers, produced a series of short videos that targeted senior high school and first-year college students. These videos demonstrate Smart Grid equipment, explain electrical engineering concepts, and portray careers in electrical manufacturing. The "Vids 4 Grids: New Media for the New Energy Workforce" project produced a total of 12 videos and 3 podcasts, which were uploaded to NEMA's Vids4Grids YouTube channel. As of project completion on December 15, 2011, the videos and podcasts had received a total of 91,990 views and the YouTube channel had 648 subscriptions.

(3) It is important that a Smart Grid program cover numerous topics, be flexible enough to frequently update the curricula to keep up with changes in the technologies, and include research activities to help students stay informed of latest developments.

- (Project OE0000398) Centralia Community College enhanced Smart Grid education across the Pacific Northwest. Significant effort was invested to create the new Pacific Northwest Center of Excellence for Clean Energy web portal (www.cleanenergyexcellence.org) and ongoing updates ensures material content is current. As part of the project, Idaho State University developed a course on supervisory control and data acquisition systems, and Montana developed a Smart Grid teaching toolkit accompanied by home-area network displays and digital video displays. Spokane Community College coordinated with Avista Utilities to offer a Pre-Apprentice Lineworker Program, which attracted 133 applicants—48 of whom were accepted and enrolled in the program.

- (Project OE0000469) Ivy Tech Community College embedded Smart Grid topics into a large number of courses. In collaboration with Purdue University, Ivy Tech created or modified 59 courses that dealt with the Smart Grid and in turn minimized the education-workforce gap in Indiana's electric energy sector. In doing so, Ivy Tech surpassed its initial goal of developing or modifying 33 courses.

- (Project OE0000464) Pratt Community College and its project partners delivered a portfolio of learning materials that gave students both a theoretical and practical education in Smart Grid concepts. Some materials trained students to use an oscilloscope, familiarized them with phasor and harmonic analyzers, and demonstrated how to measure three-phase power. Others consisted of laboratory units that focused on the fundamentals of electrical power technology; power, phasors, and impedance in AC circuits; special transformer connections; the fundamentals of rotating machines; DC motors and generators; and many other subjects. The end approach was less structured than what had been originally outlined and therefore more flexible in developing the online learning materials.

(4) Financial aid is important in attracting and retaining students.

- (Project OE0000457) Salt Lake Community College overcame potential barriers of student entry into the program, caused by an inability to pay for the tuition. Financial aid, short-term intensive loans, scholarships, corporate tuition reimbursement and subsidies from industry, helped to ensure that students could participate in the program. As a result of this project, there were 974 graduates in Technician Training Program.

- (Project OE0000443) Michigan Strategic Fund established the Michigan Utility Workforce Development Consortium. The consortium brought together more than 25 partners from industry, labor, associations, and academia to find ways to meet the industry's workforce needs. High-tech training in the power sector was offered through community colleges and utility/union training trusts, including pre-apprenticeship, apprenticeship, and incumbent worker training. Michigan Works! partners helped to identify eligible participants and direct them toward the appropriate training pathway. As a result of this project, there were 232

graduates in a Pre-Apprenticeship Training Program, 62 graduates in an Other Occupation Specific Training Program, and 137 graduates in an Apprenticeship Training Program.

Additional information regarding these projects is available in attached project fact sheets which include details on the projects' scopes and results. The information provided in the fact sheets adheres to standard practices for confidentiality of proprietary business information. For more information regarding the projects beyond what is provided on the fact sheets, please contact the recipients whose contact information is on the fact sheets.

CONCLUSION

By increasing awareness of careers in the electric utility industry, establishing a more robust pipeline, developing community and regional infrastructure that is expected to provide long-term sustainability, and enrolling and training significantly more students than originally expected, the Workforce Training for the Electric Sector Program recipients made progress in preparing the next generation of workers in the utility and electrical manufacturing industries. The Program is expected to spur the development of other programs across the U.S. in the future, allowing the nation to continue building a well-trained, highly-skilled workforce that is prepared to support the grid of the future.

APPENDIX 1:
AWARDEE DETAILS

RECIPIENT	CID	TITLE OF PROJECT	TOPIC AREA	PERIOD OF PERFORMANCE	FINAL FEDERAL SHARE	FINAL RECIPIENT SHARE
Ameren Services Company, Inc.	0425	Smarter Workforce Training Program	B	6/10/2010-6/11/2014	$843,007	$843,007
Austin Community College	0426	Preparing Occupations for Lineman Education	A	5/20/2010-4/19/2011	$87,134	$49,694
Bismarck State College	0459	National Energy Center Excellence Smart Grid Laboratory (GridLab)	A	6/15/2010-9/14/2014	$728,060	$105,307
CAEL	0450	EPCE Workforce Preparedness for Smart Grid Deployment Project	B	6/14/2010-6/14/2014	$2,549,465	$2,549,467
Centralia Community College	0398	Northwest Center of Excellence for Clean Energy Smart Grid Workforce Development	B	8/1/2010-10/29/2013	$4,998,859	$7,875,067
Clemson University Electric Power Research Association	0466	Power Industry Essentials Certificate Program	A	6/22/2010-6/21/2014	$733,901	$83,082
Community College of Rhode Island	0477	Electrical Power Technician Program	A	7/30/2010-9/30/2015	$745,739	$174,488
Consolidated Edison Company	0455	Control Center Training for Smart Grid Operation	B	1/4/2010-9/30/2013	$223,865	$223,864
Critical Intelligence, Inc.	0474	Intelligence Training for Targeted Cyber Attacks	A	8/13/2010-8/12/2013	$321,161	$64,410
Cuyahoga Community College	0448	Increasing Competitiveness of the Electric Power Sector through Responsive Workforce Training Strategies	A	7/19/2010-9/30/2013	$749,204	$95,055
Duke Energy Business Services LLC	0399	Smart Grid Workforce Training	B	6/1/2010-5/31/2013	$402,601	$402,601
Florida Power and Light Company	0435	Gateway to Power: Development of Innovative Strategic Electric Power, Renewable Energy, and Smart Grid Workforce	B	8/1/2010-7/31/2013	$4,867,375	$7,610,009

RECIPIENT	CID	TITLE OF PROJECT	TOPIC AREA	PERIOD OF PERFORMANCE	FINAL FEDERAL SHARE	FINAL RECIPIENT SHARE
General Electric Company	0499	Training for the Development of a Smart Grid Center of Excellence	B	7/23/2010-7/22/2013	$634,312	$642,849
Georgia Institute of Technology	0461	Electrical Power Transmission and Distribution Connector Selection and Installation Training	A	5/27/2010-5/27/2013	$642,574	$71,996
Glendale Community College	0490	Southern California Utility Initiative	A	7/16/2010-7/15/2014	$750,000	$94,396
Illinois Institute of Technology	0449	Smart Grid Education and Workforce Training Center	B	8/16/2010-8/13/2014	$4,999,999	$7,632,795
Incremental Systems Corporation	0488	Massive Real-time Simulations for Training Smart Grid Operators	B	7/15/2010-7/14/2013	$3,600,000	$4,756,283
Iowa Valley Community College District	0438	Iowa Valley Collaborative Lineworker Training and Awareness Project	A	7/20/2010-7/20/2013	$428,874	$158,600
Ivy Tech Community College	0469	Crossroads Smart Grid Training Program	B	7/1/2010-9/30/2013	$4,699,353	$4,963,884
Key Training Corporation	0439	Grid Training Modernization Project	A	7/23/2010-7/22/2013	$750,000	$1,467,938
Lehigh University	0428	Keystone Smart Grid Fellowship Program	A	7/30/2010-6/30/2015	$748,058	$239,494
Michigan Strategic Fund	0443	Michigan Electric Power Workforce Training Strategy	B	7/30/2010-7/29/2014	$4,388,025	$6,798,131
Mississippi Gulf Coast Community College	0484	Workforce Development for the Electric Power Sector	A	8/1/2010-7/31/2013	$713,830	$655,399
National Electrical Manufacturers Association	0463	Vids for Grids: New Media for the New Energy Workforce	A	7/16/2010-12/15/2011	$165,876	$153,367
Navajo Tribal Utility Authority	0442	Smart Grid Workforce Training	B	7/1/2010-6/30/2013	$704,486	$704,486

RECIPIENT	CID	TITLE OF PROJECT	TOPIC AREA	PERIOD OF PERFORMANCE	FINAL FEDERAL SHARE	FINAL RECIPIENT SHARE
North Carolina State University	0437	Master of Electric Power Systems Engineering	STEPS	6/30/2010-6/30/2015	$2,492,266	$953,158
Northeast Wisconsin Technical College	0445	NEW Generation Power Skills Training Development Initiative	A	7/1/2010-6/14/2013	$750,000	$109,233
Northern Michigan University	0444	Electrical Power Technician Workforce Training Program	A	6/9/2010-6/8/2013	$673,462	$131,905
The Ohio State University	0402	I-Smart: Integrated Curriculum for Smart Power Engineering	STEPS	5/13/2010-9/30/2013	$2,499,939	$1,296,545
ONCOR Electric Delivery Company LLC	0456	Grid Reliability through Engineering Advancement and Training	B	6/10/2010-6/9/2013	$150,969	$180,481
Oregon Institute of Technology	0404	Strategic Training and Education in Power Systems	STEPS	7/7/2010-7/6/2013	$2,491,100	$377,965
PEPCO Holdings, Inc.	0393	Smart Grid Workforce Training Project	B	4/30/2010-9/30/2013	$3,978,348	$3,893,580
Pratt Community College	0464	Smart Grid Curriculum Development	A	8/1/2010-7/31/2013	$749,375	$117,831
Princeton Energy Resources International, LLC.	0440	Mid-Atlantic Renewable Energy Education Program for Rural Electric Power Sector	A	7/30/2010-7/31/2015	$615,345	$249,904
University of Colorado - Boulder	0436	Strategic Networking Training for Power Systems	STEPS	7/1/2010-5/31/2014	$1,629,429	$276,736
University of Minnesota	0427	Revitalization of Electric Power Engineering Education	STEPS	7/30/2010-7/29/2014	$2,485,058	$1,695,423
Salt Lake Community College	0457	Workforce Training in Utah's Electric Power Sector	A	7/29/2010-9/30/2013	$614,240	$417,671
Salt Lake Community College	0458	Utah's Smart Grid Training	B	7/29/2010-9/30/2013	$1,523,005	$1,530,894

RECIPIENT	CID	TITLE OF PROJECT	TOPIC AREA	PERIOD OF PERFORMANCE	FINAL FEDERAL SHARE	FINAL RECIPIENT SHARE
Savannah Technical College	0476	Electric Utility Industry Workforce Development	A	8/6/2010-8/5/2013	$695,100	$393,597
Syracuse University	0495	Multi-Institutional Curriculum Development and Delivery to Create the New Smart Grid Workforce	STEPS	8/9/2010-8/8/2014	$2,461,378	$534,080
Pennsylvania State University	0506	GridSTAR Center: Smart Grid Training and Application Resource Center	B	8/5/2010-8/30/2014	$5,000,000	$5,000,000
University Enterprises, Inc.	0492	California Smart Grid Workforce Development Network	A	7/20/2010-9/19/2013	$749,992	$83,351
University of Hawaii at Manoa	0394	Integrated Education and Research in Clean Energy and Island Sustainability-Electric Power Sector Training	STEPS	5/4/2010-6/30/2014	$2,500,000	$277,778
University of Hawaii Systems	0430	Education and Research in Clean Energy and Island Sustainability	A	7/30/2010-7/31/2013	$750,000	$132,956
University of Houston	0485	Smart Grid Energy Training Coalition	STEPS	8/1/2010-12/30/2014	$2,468,987	$1,228,451
University of Kentucky	0409	Power and Energy Education Institute	STEPS	5/4/2010-5/13/2014	$2,496,891	$515,030
University of Tennessee at Chattanooga	0413	Workforce Training for the Electric Power Sector	STEPS	6/28/2010-6/27/2014	$2,316,768	$322,402
Washington State University	0486	Training in Clean Energy Smart Grid Engineering	STEPS	8/1/2010-7/31/2013	$2,233,791	$1,721,828
Workforce Development Institute, Inc.	0491	Development of a Smart Grid Lineman Workforce	B	7/30/2010-6/30/2014	$1,558,436	$1,558,436

APPENDIX 2:
PROJECT FACT SHEETS

Ameren Services Company

Smarter Workforce Training Program

Project Description

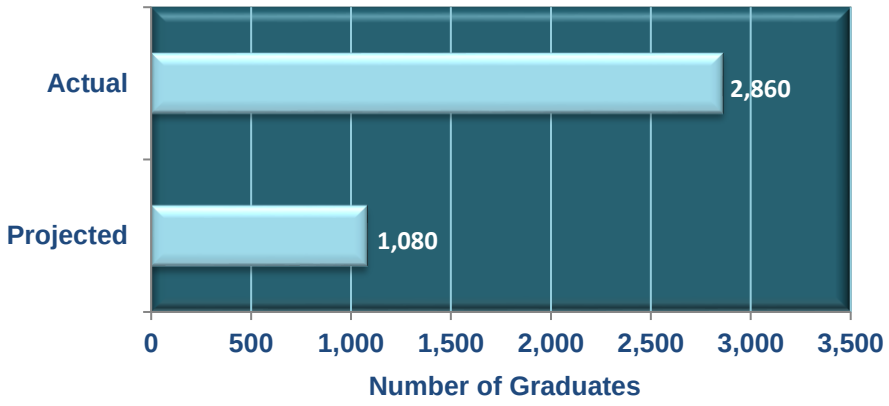
Ameren Services Company (Ameren) designed the Smarter Workforce Training Program to facilitate the development of a well-trained, highly skilled workforce for the electric power sector. Such a workforce is vital to implementing a clean-energy smart grid nationwide. The program addressed Ameren's training needs in three smart grid areas: (1) advanced distribution management systems (ADMSs), (2) a new geographic information system (GIS) functionality (i.e., a mapping system), and (3) other smart devices for Ameren's electric distribution system.

Achievements

Of the 2,860 individuals who completed the coursework, 183 had been recently hired or were new to their role. The other 2,677 individuals were obtaining new skills—or improving their existing skills—while remaining in their current role. Most of the students who took the courses were linemen, but supervisors, customer service representatives, engineers, and field representatives also made up substantial minorities of the student body. Gas workers, meter and maintenance workers, mechanics, and distribution specialists were some of the many other types of professionals who finished the coursework.

Delays hampered the project, yet despite these setbacks, the courses' learning objectives were met. The results of training evaluations indicate that the students gained enhanced knowledge of smart grid topics and technologies, as Ameren intended. Students found the training in ORMap and in supervisory control and data acquisition especially relevant; they had ample opportunities to apply what they learned in their day-to-day activities.

Because the courses provided the desired impact as designed, Ameren will continue to offer the courses as needed—as employees move into new roles, for instance, or as employees who keep their current roles need refresher training.



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PARTNERS

None Listed

PROJECT DURATION

6/10/2010–6/11/2014

COST

Total Project Value
$1,686,014

DOE/Non-DOE Share
$843,007/$843,007

PROJECT LOCATION

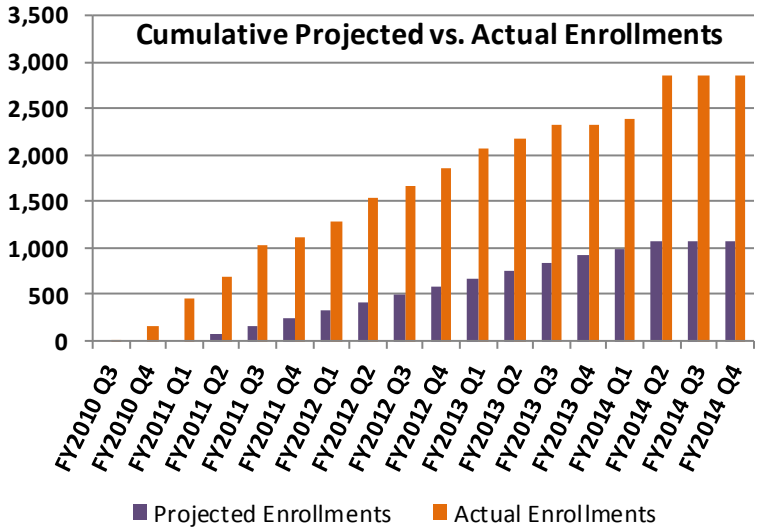
Missouri

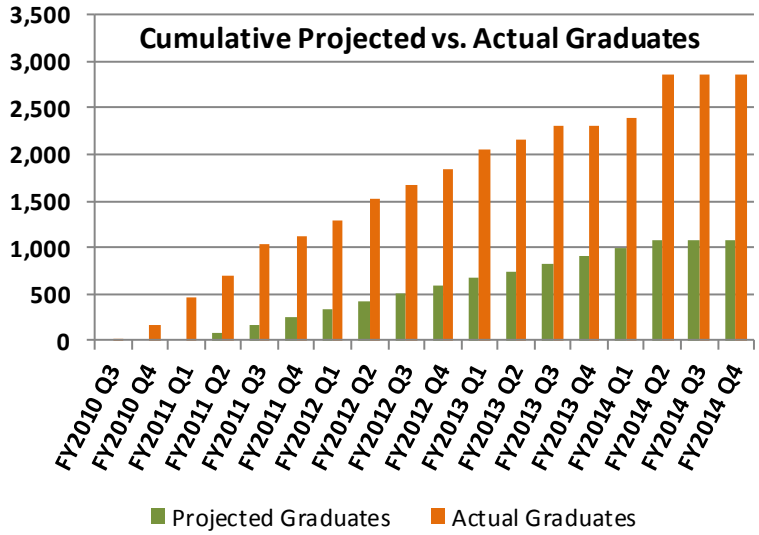
CID: OE0000425

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Utility Training Program	
Projected Number of Enrollments	1080
Actual Number of Enrollments	2860
Projected Number of Graduates	1080
Actual Number of Graduates	2860





Austin Community College

Preparing Occupations for Lineman Education

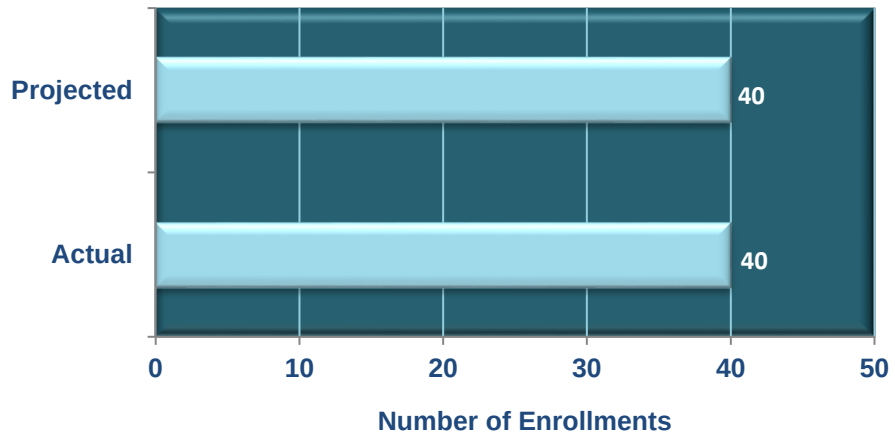
Project Description

Austin Community College District's Preparing Occupations for Lineman Education (POLE) Program facilitated smart grid implementation by providing a pipeline of workers (utility linemen) to enable smart grid functionality and support economic recovery by connecting job seekers with training and employment opportunities. The POLE Program developed the curricula for a utility lineman certificate and an associate of applied science degree. Courses taught industry-required topics such as electrical safety codes, climbing skills, power transmission, and switching and metering. The curricula were devised by an advisory committee tasked with conducting a systematic assessment of the skills and competencies required for the occupation. The project also utilized professional curriculum developers to incorporate these skills into a 5-semester utility lineman associate degree and a 1-year utility lineman certificate, and to begin recruiting job seekers for the training programs.

Achievements

Curriculum development included making the National Electric Safety Code course into a hybrid course that supplemented in-person classes with online instruction. Other courses (offered as lectures) that made up the program included Climbing Skills I and II, Distribution Operations, Principles of Power Transmission, Principles of Switching and Metering, and Smart Grid Technology.

The project team generated brochures and flyers to garner interest in the POLE Program. A website was developed to draw attention to the POLE Program as well. A Utility Lineworker Expo event was another means of outreach. At the expo, utility representatives demonstrated the tasks they perform on the job and spoke with attendees in an effort to recruit new workers to the industry.



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PARTNERS

None Listed

PROJECT DURATION

5/20/2010–4/19/2011

COST

Total Project Value
$136,828

DOE/Non-DOE Share
$87,134/ $49,694

PROJECT LOCATION

Texas

CID: OE000426

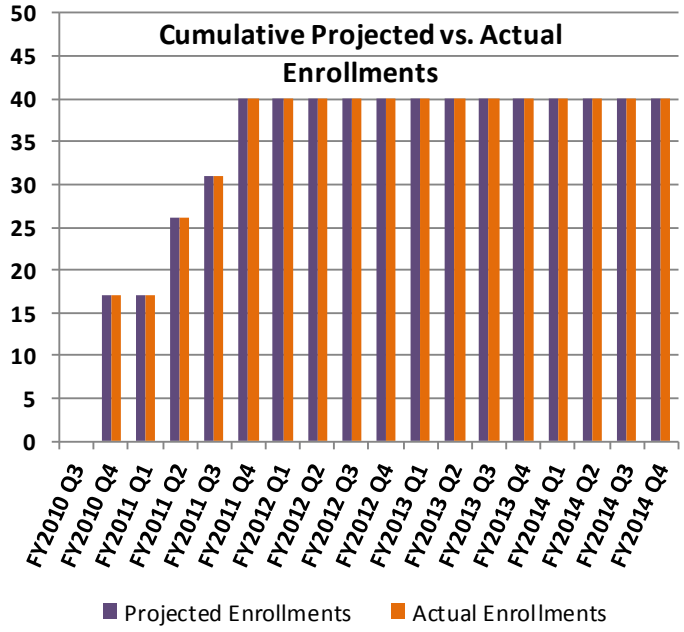
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

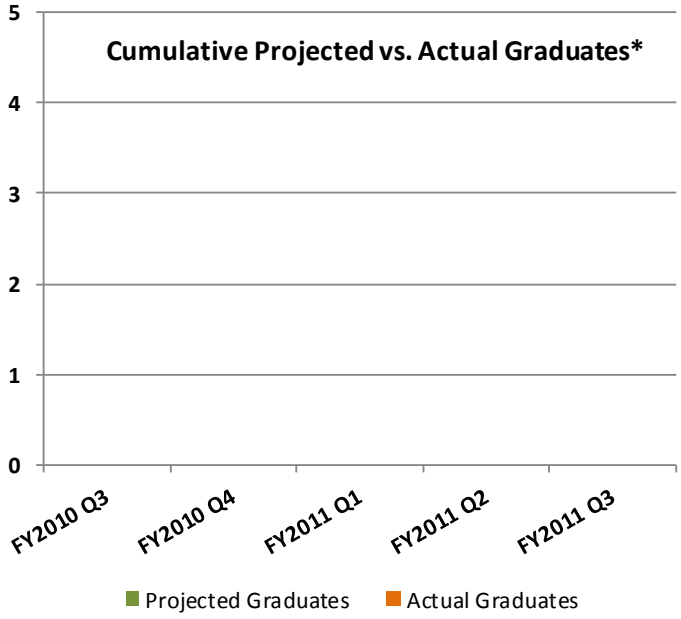
AUSTIN COMMUNITY COLLEGE

Metrics

Total Course Data	
Associates of Applied Science in ET	
Projected Number of Enrollments	40
Actual Number of Enrollments	40
Projected Number of Graduates	0*
Actual Number of Graduates	0*

*Recipients were required to report projected enrollments and graduates that occurred only during the project performance period of the grant.





*Graduates were not projected to be realized before the grant period was exhausted. Fall 2010 was the first semester students entered the program and, therefore, no students had completed the program by the end of the grant period. The first student was expected to complete the Associates Degree POLE program in Spring 2012.

Bismarck State College

National Energy Center Excellence Smart Grid Laboratory (GridLab)

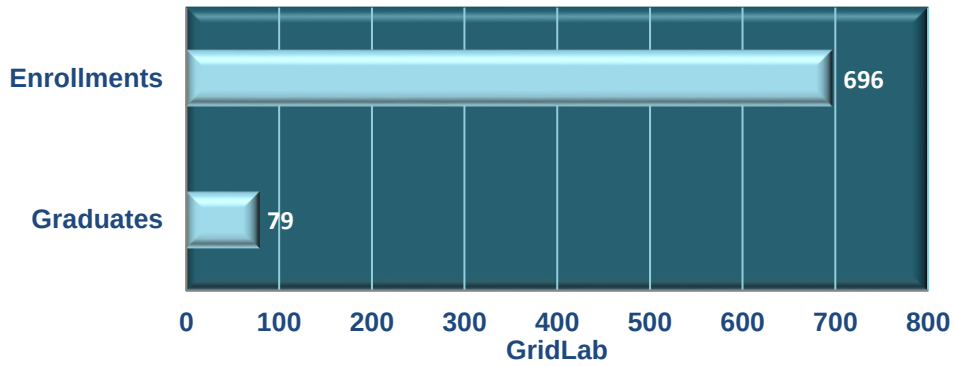
Project Description

Bismarck State College built a new laboratory (GridLab) to assist classroom and online workforce training in the areas of smart grid technology, distributed generation, demand response, and consumer integration of smart technologies. GridLab is a complete, integrated smart grid with a mock smart home, industrial loads, distributed and renewable generation, and advanced communication and control systems. It is interconnected and controlled from a web-based, advanced, smart control system that allows real-time access to facility energy data. Multiple scenarios have been tested to simulate various smart grid implementation and energy rate structures. GridLab can be operated locally or remotely. The GridLab Human Machine Interface is web-based and can be accessed from anywhere an internet connection is available.

Achievements

Bismarck State College succeeded in establishing GridLab, incorporating both renewable and fossil-fuel generation. Bismarck State College took into account the most current technologies available during GridLab's design and deployed modern electricity- and fuel-monitoring sensors as GridLab was built. These sensors—along with other devices—reflect both real-time and historical data to give users a broader range of information. They are also accessible via the web, which increases students' and researchers' access.

The GridLab project encompassed undergraduates enrolled in Introduction to Energy Technology, Electrical Fundamentals, Plant Equipment & Systems, and Energy Sources & Conversions. In addition, on-campus graduate students used GridLab to pursue programs in power plant technology, process plant technology, and renewable generation technology. Bismarck State College plans to incorporate GridLab into more energy programs, which could include Petroleum Production Technology, Nuclear Power Technology, Electric Transmission System Technology, Electric Power Technology, and Lineworkers.



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PARTNERS

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PROJECT DURATION

6/15/2010–9/14/2014

COST

Total Project Value
$833,367

DOE/Non-DOE Share
$728,060/$105,307

PROJECT LOCATION

North Dakota

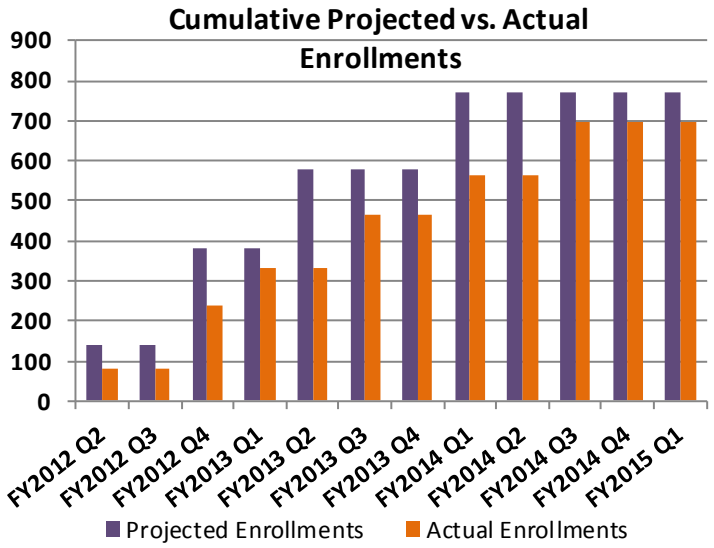
CID: OE0000459

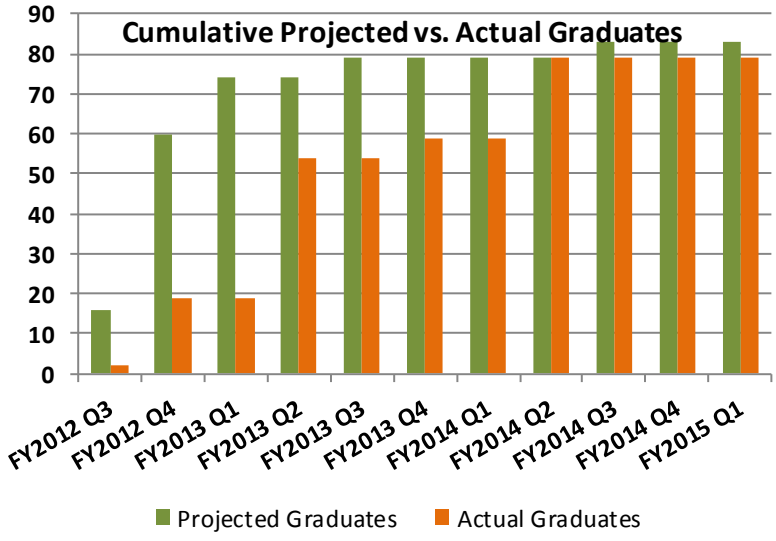
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

BISMARCK STATE COLLEGE

Metrics

Total Course Data	
GridLab	
Projected Number of Enrollments	772
Actual Number of Enrollments	696
Projected Number of Graduates	83
Actual Number of Graduates	79





Council for Adult and Experiential Learning

EPCE Workforce Preparedness for Smart Grid Deployment Project

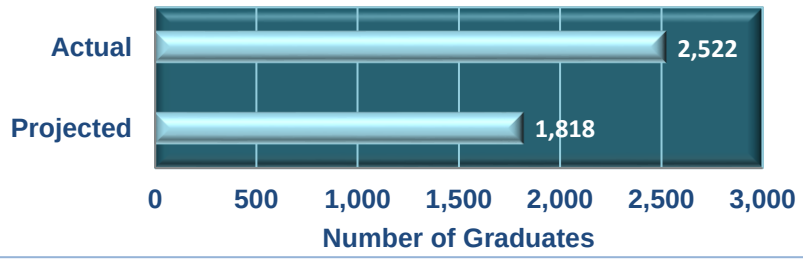
Project Description

The project leveraged the existing capacity and distinctive features of the Energy Providers Coalition for Education (EPCE) model for developing and delivering industry-endorsed, standardized, continuously updated online technical training and education. The project employed a number of training strategies aligned with employer needs and used existing and new online electric power technology coursework developed by Bismarck State College (BSC).

Achievements

The Council for Adult and Experiential Learning (CAEL) delivered three smart grid training courses through BSC, a project partner. At the request of utility employer partners, students completed the coursework online instead of attending traditional classes. This format better accommodated their field and shift work. Upon completing one of the three courses—Renewable Energy Sources and the Smart Grid, Operation Considerations for the Smart Grid, and Impact of the Smart Grid—students earned a continuing education unit. These smart grid courses were integrated into EPCE's curriculum for its associate's degree in electric power technology.

When it became apparent there was a need for an additional course devoted to customer service representatives, CAEL developed one—called Smart Grid, Smart Customer. In fact, customer service representatives were the types of workers most commonly trained through CAEL's program. But a wide range of utility professionals participated in the program as well. These included advanced system operators, electrical engineers and electricians, lineworkers, and transmission planners. In addition, CAEL exposed 22 high school students to EPCE's online program and gave them hands-on experience through a paid summer internship at an electric utility.



Success Story

One student who participated in CAEL's high school program was so inspired by the experience that he decided to pursue an electrician career with the U.S. Marine Corps. The online courses he took helped dramatically improve his scores on the Armed Services Vocational Aptitude Battery test. He is now an 1141 Electrician with the Marine Corps.

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American Public Power Association
Commonwealth Edison
Oklahoma Gas & Electric
JEA
PJM Interconnection
National Rural Electric Coop Assoc.
Bismarck State College
Virtual High School
CT Community College System
CEWD

PROJECT DURATION

6/14/2010–6/14/2014

COST

Total Project Value
$5,098,932

DOE/Non-DOE Share
$2,549,465/$2,549,467

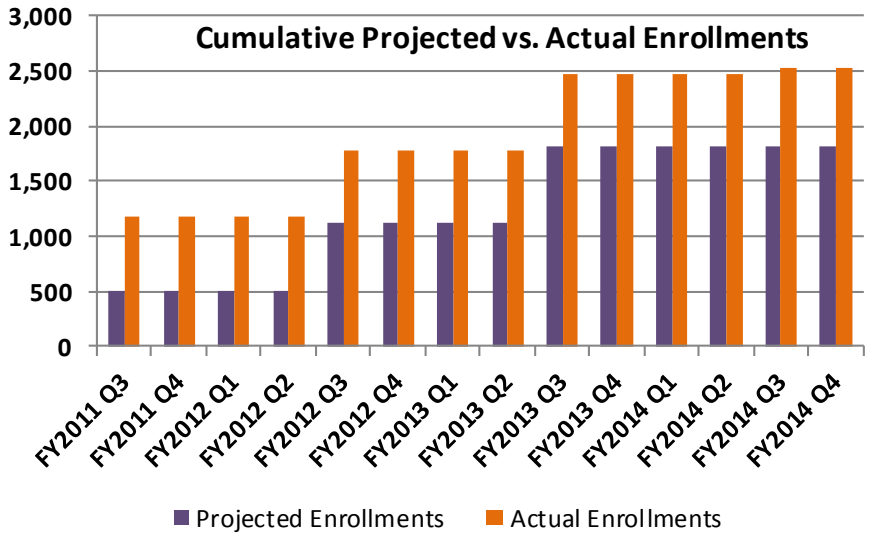
PROJECT LOCATION

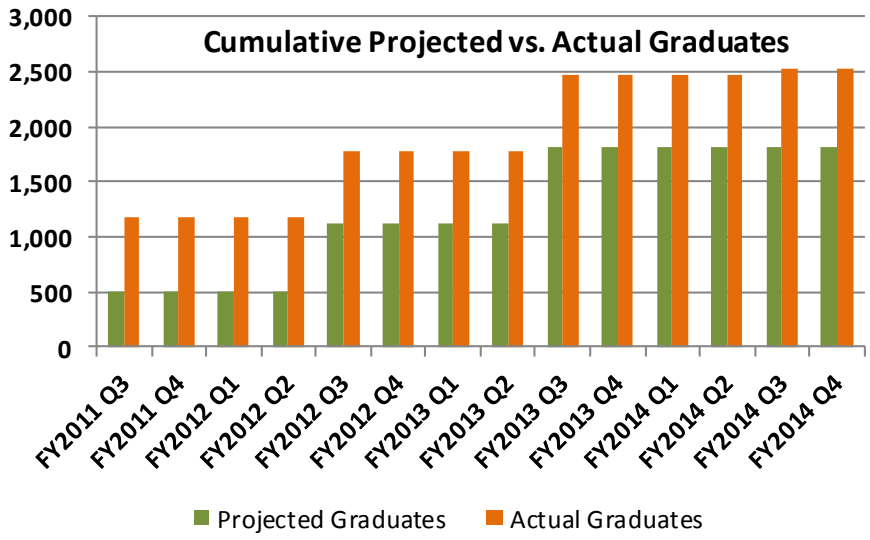
Colorado
CID: OE0000450

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Technician Training Programs	
Projected Number of Enrollments	1,818
Actual Number of Enrollments	2,522
Projected Number of Graduates	1,818
Actual Number of Graduates	2,522





Centralia Community College

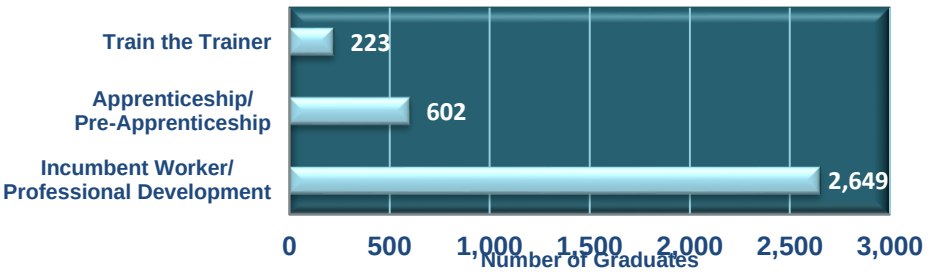
Northwest Center of Excellence for Clean Energy: SMART Grid Workforce Development

Project Description

The project established the Pacific Northwest Center of Excellence for Clean Energy within Washington State's Centralia College. Utilities, Bonneville Power Administration, Pacific Northwest National Laboratory, community colleges, and universities collaborated to train instrument control and relay specialists; generation, load, and substation operators; line workers, substation wiremen, and mechanics; and meter technicians—as well as energy conservation program administrators and resource conservation managers. Training was provided through satellite centers in Washington, Oregon, Idaho, and Montana. In addition, the Utah-based WestCAMP developed safety and hazard-prevention training for all line workers, manufacturing and construction personnel, or technicians who will work with smart grid technologies.

Achievements

The project enhanced smart grid education across the Pacific Northwest. As part of the project, Idaho State University developed a course on supervisory control and data acquisition systems, and Montana developed a smart grid teaching toolkit accompanied by home-area network displays and digital video displays. Spokane Community College coordinated with Avista Utilities to offer a Pre-Apprentice Lineworker Program, which attracted 133 applicants—48 of whom were accepted and enrolled in the program. The Compton Training Substation satellite center, also in Spokane, delivered training modules on switching and tagging, capacitors, and regulatory theory. At Portland State University, a workshop about trends in the electric utility industry was held for senior leaders from Bonneville Power Administration. Finally, approximately 100 relevant training modules had been uploaded to the National Training and Education Resource platform as of July 2013.



Success Story

Centralia expected to train just 1,215 individuals as part of the project's incumbent worker training program, but by partnering with industry (such as Avista Utilities), Centralia surpassed those expectations by training 2,649

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Bonneville Power Administration
Pacific Northwest National Laboratory
Avista Utilities
Puget Sound Energy
Seattle City Light
Idaho Power
IBEW
AFL-CIO
Veterans Conservation Corps
Community Colleges and Universities

PROJECT DURATION

8/1/2010–10/29/2013

COST

Total Project Value
$12,873,926

DOE/Non-DOE Share
$4,998,859/$7,875,067

PROJECT LOCATIONS

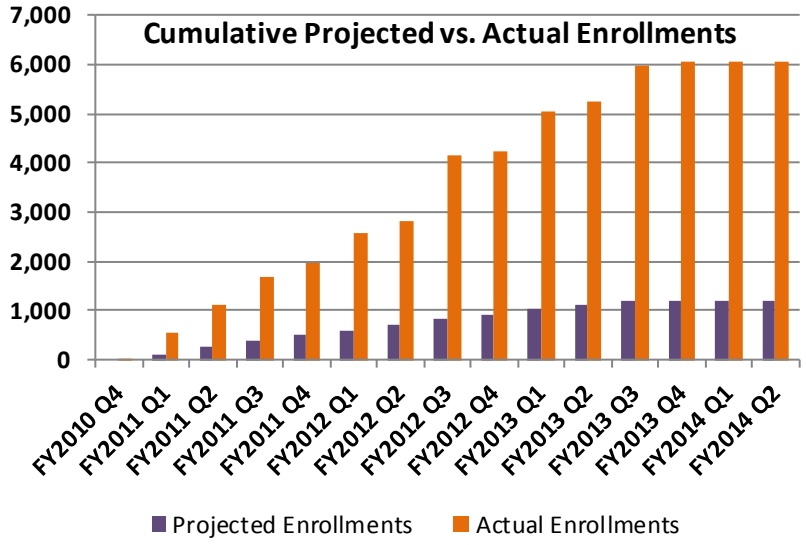
Washington, Idaho, Montana, Oregon, Utah
CID: OE0000398

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

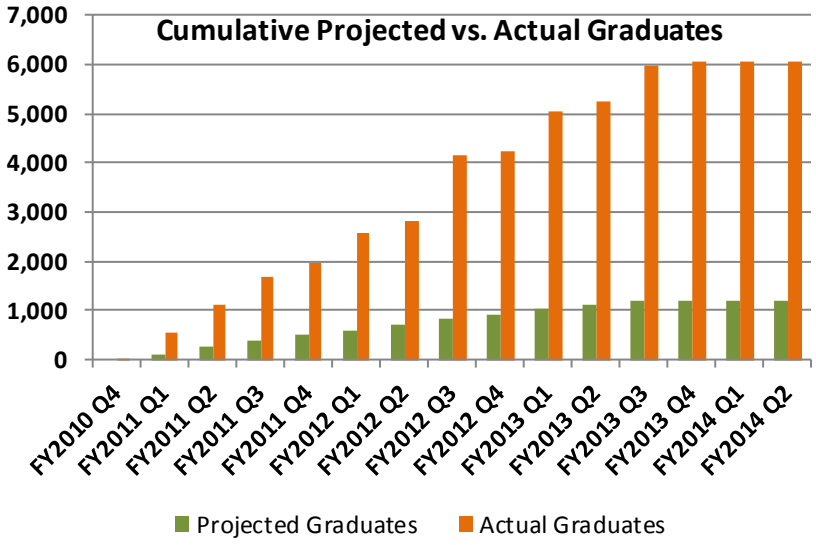
Metrics

Total Course Data			
Incumbent Worker/Pro Development		**Apprenticeship/Pre-Apprenticeship**	
Projected Number of Enrollments	1215	Projected Number of Enrollments	0*
Actual Number of Enrollments	2649	Actual Number of Enrollments	602
Projected Number of Graduates	1215	Projected Number of Graduates	0*
Actual Number of Graduates	2649	Actual Number of Graduates	602
Train the Trainer		**K-12 Outreach**	
Projected Number of Enrollments	0*	Projected Number of Enrollments	0*
Actual Number of Enrollments	223	Actual Number of Enrollments	2577
Projected Number of Graduates	0*	Projected Number of Graduates	0*
Actual Number of Graduates	223	Actual Number of Graduates	2577

*It was not expected that these program areas would produce enrollments and graduates during the project period of performance, but a strong relationship with Avista led to enrollments and graduates from these programs.



The original training projection was 1,215 individuals, but the partnership with industry such as Avista far surpassed the expectation with their incumbent worker training program. Project also claims 2,577 individuals in the K-12 outreach program.



Clemson University Electric Power Research Association
Power Industry Essentials Certificate Program

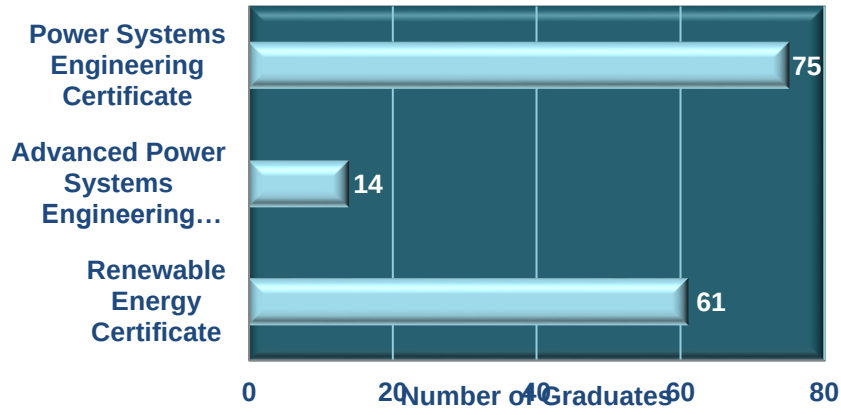
Project Description

Clemson University Electric Power Research Association developed online certificate programs in power systems engineering, renewable energy, and advanced power systems. Three groups were targeted as program candidates: electrical engineering graduates who lacked power systems training coursework, engineering graduates who lacked renewable energy coursework, and electrical engineering graduates who had only a basic understanding of power systems. In addition, a master's degree in engineering was developed.

Achievements

Students earning a certificate in power systems engineering took courses in power systems analysis and electric machinery, among others. The certificate program in advanced power systems included courses in power systems protection, real-time computer applications in power systems, and the dynamics and stability of power systems. Courses devoted to wind power, solar energy, and the integration of renewable energy and the grid constituted the renewable energy program. Most of the students who completed the coursework were offered positions in various industries and with electric utilities, such as Duke Energy, SCE&G, Santee-Cooper, Georgia Power, Itron, Dow Corning, and Advanced Energy. The students' placement in the labor market is a testament to the training's relevance and quality.

In the future, all of the online coursework will be offered to other universities and companies through Clemson University's Electrical and Computer Engineering Department website. The coursework will be expanded to cover smart grid concepts, microgrids, and the use of phasor measurement units. It will also rely more heavily on Clemson University's Wind Turbine Drivetrain Testing Facility to give students more hands-on experience with wind turbines.



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PARTNERS

None Listed

PROJECT DURATION

6/22/2010–6/21/2014

COST

Total Project Value
$816,983

DOE/Non-DOE Share
$733,901/$83,082

PROJECT LOCATION

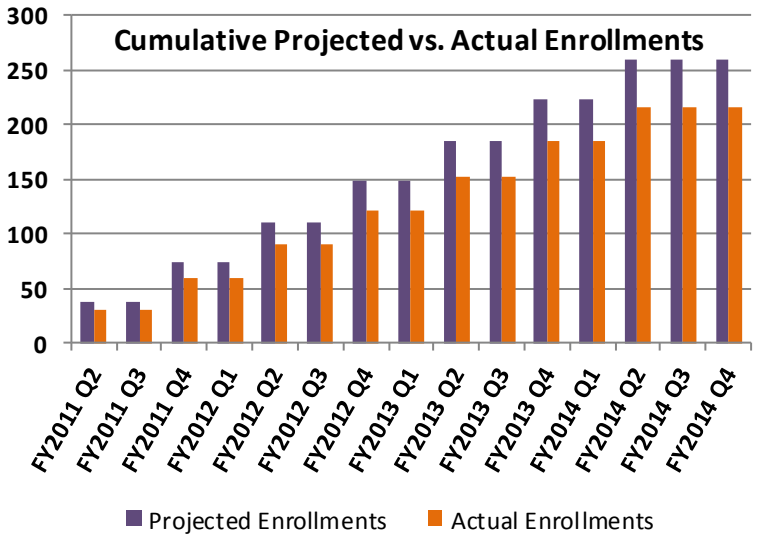
South Carolina

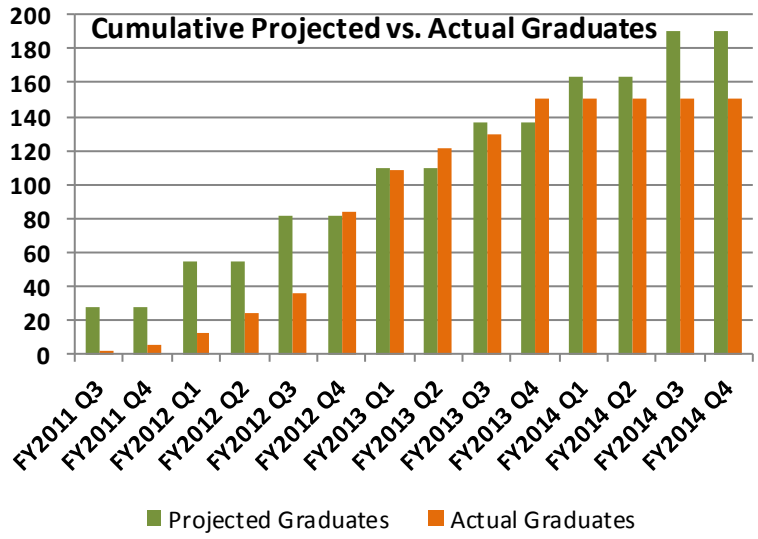
CID: OE0000466

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
Advanced Power Systems Engineering Certificate		**Power Systems Engineering Certificate**		**Renewable Energy Certificate**	
Projected Number of Enrollments	20	Projected Number of Enrollments	140	Projected Number of Enrollments	100
Actual Number of Enrollments	16	Actual Number of Enrollments	112	Actual Number of Enrollments	88
Projected Number of Graduates	20	Projected Number of Graduates	110	Projected Number of Graduates	60
Actual Number of Graduates	14	Actual Number of Graduates	75	Actual Number of Graduates	61





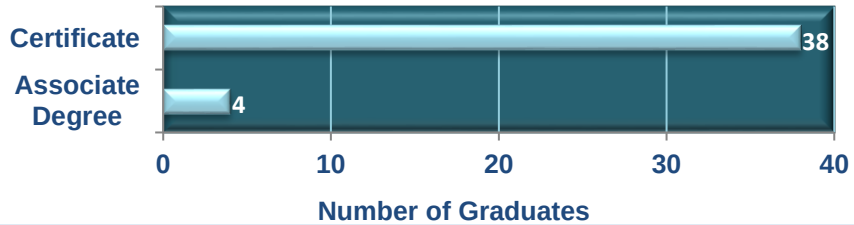
Community College of Rhode Island
Electrical Power Technician Program

Project Description

The Community College of Rhode Island (CCRI) and industry partner National Grid developed and implemented a new certificate in energy utility technology and a redesigned associate degree in engineering systems technology, both of which focus on the electric power industry. The project team based the certificate program on a program developed and tested at three Massachusetts community colleges. The team designed the curriculum to address the economic needs of the region, train incumbent and future workers, and prepare graduates to contribute to the state's workforce at various positions of the energy industry. The certificate includes classroom training, laboratory experience, and a capstone on-the-job practicum with National Grid. Students were recruited from partnering high schools, workforce development clients, and returning military. This effort included high school visits, campus tours, open-house events, and job placement assistance for program graduates.

Achievements

As a result of this program, graduates were ready to enter the energy-sector workforce upon completing their plans of study. Technicians and displaced workers, moreover, had the opportunity to increase their skill sets and raise the pay they could command. CCRI's redesigned associate degree encompasses system modeling, simulation, automation, robotics, electronics, digital systems, networking, machine design, and electrical power. Giving students an interdisciplinary view of complex systems, the program helps students solve problems creatively, master design principles and machine programming, and troubleshoot problems with computer networks and systems. Students who earn the associate degree complete such courses as Introduction to Energy Utility Industry, Electrical Power Systems, Energy Industry Safety, and Energy Industry Capstone and Practicum. The certificate program covers many of the same topics, including safety, circuits and controls, operations and technology, and the business side of the energy industry. As in the associate-level program, students pursuing the certificate participate in a practicum where they can take what they learned in the classroom and apply it in a real-world setting. Credits earned in the certificate program can apply toward the associate degree as well.



Success Story

Students who earned the certificate in electric utility technology and went on to complete the associate degree in engineering systems technology have since been hired by National Grid, with a starting pay of $35 per hour.

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PARTNERS

National Grid

PROJECT DURATION

7/30/2010–9/30/2015

COST

Total Project Value
$920,227

DOE/Non-DOE Share
$745,739/$174,488

PROJECT LOCATION

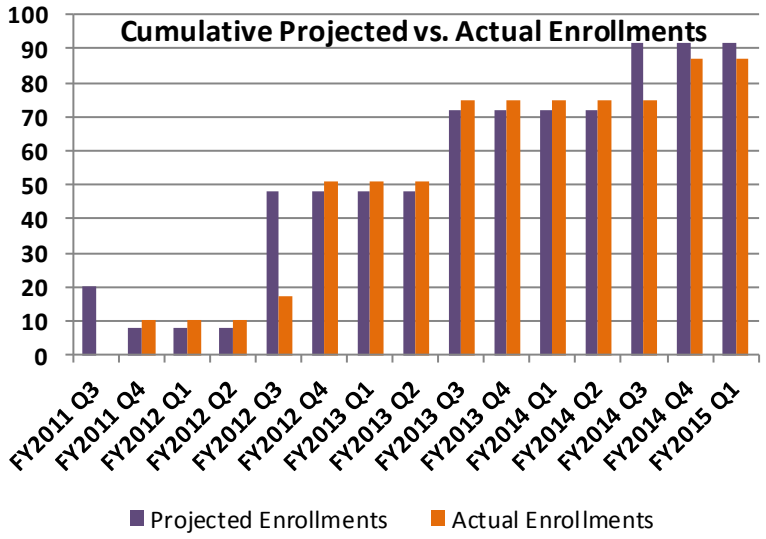
Rhode Island

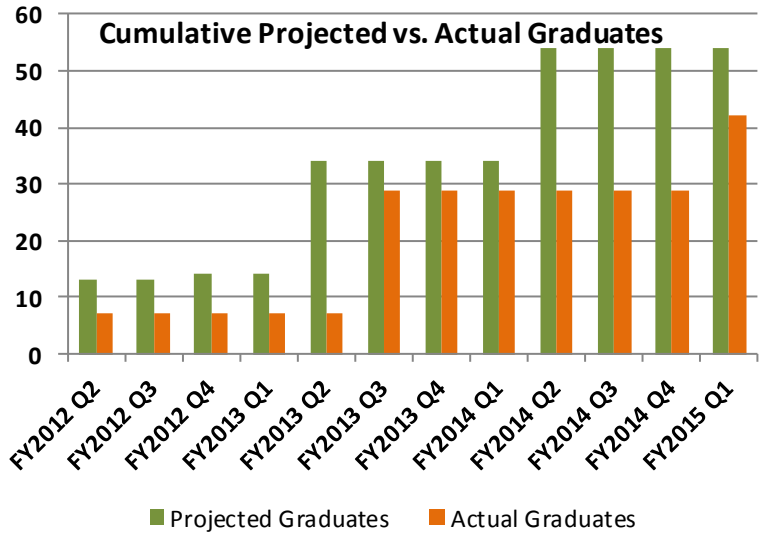
CID: OE0000477

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Certificate Program - CCRI ETUT		CCRI Associate Degree Program	
Projected Number of Enrollments	72	Projected Number of Enrollments	20
Actual Number of Enrollments	83	Actual Number of Enrollments	4
Projected Number of Graduates	49	Projected Number of Graduates	5
Actual Number of Graduates	38	Actual Number of Graduates	4





Consolidated Edison Company

Control Center Training for Smart Grid Operation

Project Description

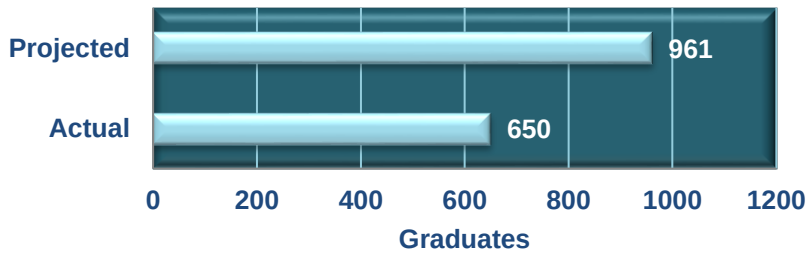
Consolidated Edison of New York (Con Edison) developed a training program to prepare its workforce to implement advanced system capabilities for the utility's electric system and customers. The curriculum included remote operation of reclosers, switches, regulators, sophisticated capacitor band controllers, supervisory controls, communication systems, and sectionalizers. It also included the management of these systems and the successful completion of North American Electric Reliability Corporation Critical Infrastructure Protection training. A novel feature of the training was the use of simulators in a distribution-control-center environment. These simulators included an integrated use of supervisory control and data acquisition (SCADA), risk management, contingency analysis, and contingency response.

Achievements

The Superstorm Sandy response hindered Con Edison's ability to reach its enrollment goals, yet the utility still trained 650 employees on the function, installation, and operation of smart grid technologies. The program included 11 courses, all of which were instituted at Con Edison's Learning Center. Some of the courses focused on specific types of smart grid equipment, such as GE's PulseNET network management system. Other courses, including those on cyber security and switching operation, were wider in scope. Con Edison will continue to offer the following courses after the funding period ends:

- Local Operation of Elastimold/VAC SCADA Switch
- Elastimold Vacuum Switch/SCADA/On-the-Job Training
- Elastimold Vacuum SCADA Switch
- SCADA Elastimold/Switch Train the Trainer
- Switching Operations
- "Technically Speaking" Seminar on DOE-Funded Smart Grid Projects

To ensure the training's value to utility employees, Con Edison included courses that equipment vendors hosted and that made use of vendors' offsite equipment. Doing so proved effective, and Con Edison has since incorporated vendor-provided training materials into courses that the utility will offer its employees in the future.



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PARTNERS

Orange and Rockland Utilities Inc.

PROJECT DURATION

1/4/2010–9/30/2013

COST

Total Project Value
$447,729

DOE/Non-DOE Share
$223,865/$223,864

PROJECT LOCATION

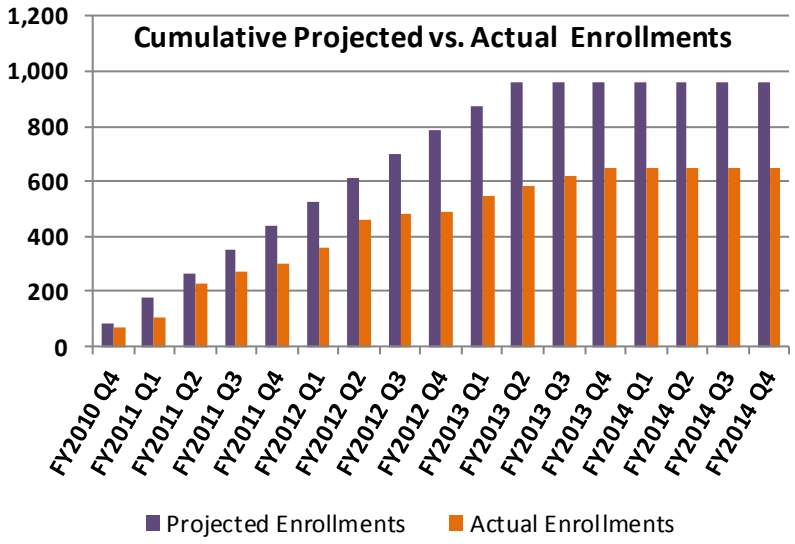
New York

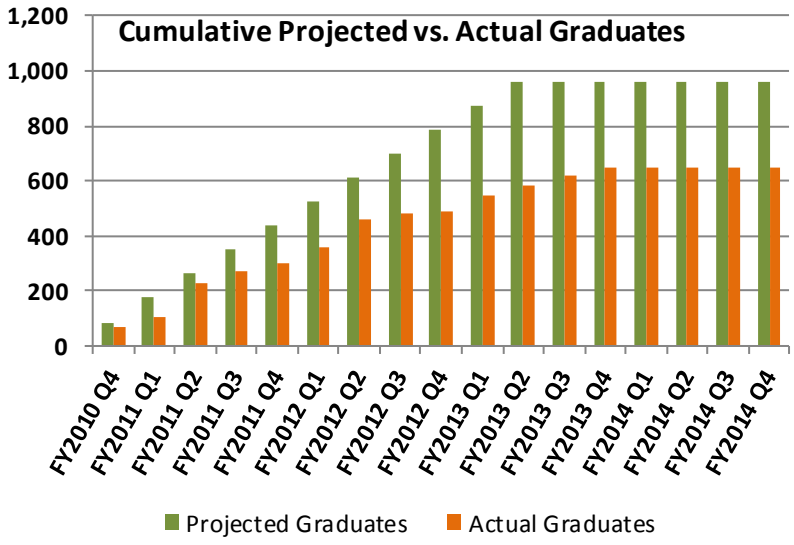
CID: OE0000455

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Utility Training Programs	
Projected Number of Enrollments	961
Actual Number of Enrollments	650
Projected Number of Graduates	961
Actual Number of Graduates	650





The targeted audience was personnel from operations, construction and engineering. Approximate head counts were used to determine the projected student body and graduates.

The main driver for the large discrepancy is attributed to (1) Program was not mandatory – scheduling and enrollment at manager's discretion (2) student availability (projected student body occupied with emergent system operation issue).

Critical Intelligence Inc.

Intelligence Training for Targeted Cyber Attacks

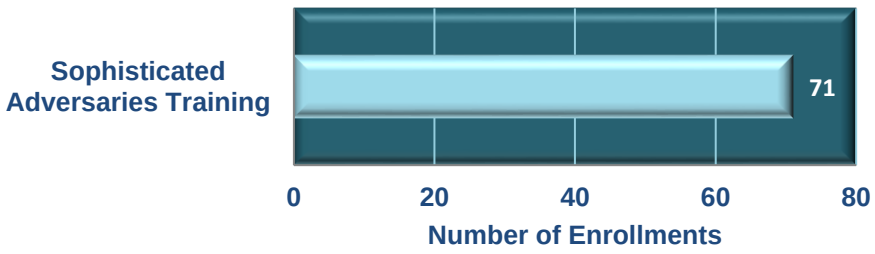
Project Description

Critical Intelligence designed a 9-week instructor-led online course that trained energy sector information security employees to detect and respond to cyber threats. Developed with energy sector partners, the course focused on building a threat intelligence program capable of identifying and responding to targeted attacks and sharing information garnered from the intelligence program with industry peers and government partners. This training differed from other programs because it was specific to the energy sector, included longer classes, eliminated travel, and allowed students to apply the techniques they learned to the tasks they performed on the job.

Achievements

Critical Intelligence fully developed the 9-week course which included roughly 10 hours of professionally recorded lectures, six quizzes which tested a student's understanding of the material and 21 assignments which were intended to enrich each student's learning experience. The course included six modules: (1) Introduction to Course, (2) Introduction to Situational Awareness and Threat Intelligence, (3) Attack Planning and Targeting, (4) Creating and Using Situational Awareness and Threat Intelligence, (5) Industrial Control Systems Cyber Threat Environment, and (6) Information Sharing. Input from the National Board of Information Security Examiners shaped each module's content. More than 70 cybersecurity professionals from 20 utilities helped to vet the course. The learning management system that Critical Intelligence used to deliver the course remotely performed as envisioned, easily accommodating up to 30 students per class.

Although no students have yet completed all of the classwork and associated exercises that the course encompasses, they did validate the course's usefulness and confirmed that the learning management system performed well. This process also shed light on barriers that full-time cyber security professionals must overcome when they complete training online—namely, waning enthusiasm. As a result, Critical Intelligence is now considering the option to offer the training as a 3-day in-person session to maintain student interest. Another option is to simply offer the 6-week training as a standalone course in its current format.



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PARTNERS

Constellation Energy
Electric Sector Security Consortium
North American Electric Reliability Corporation

PROJECT DURATION

8/13/2010–8/12/2013

COST

Total Project Value
$385,571

DOE/Non-DOE Share
$321,161/$64,410

PROJECT LOCATION

Idaho

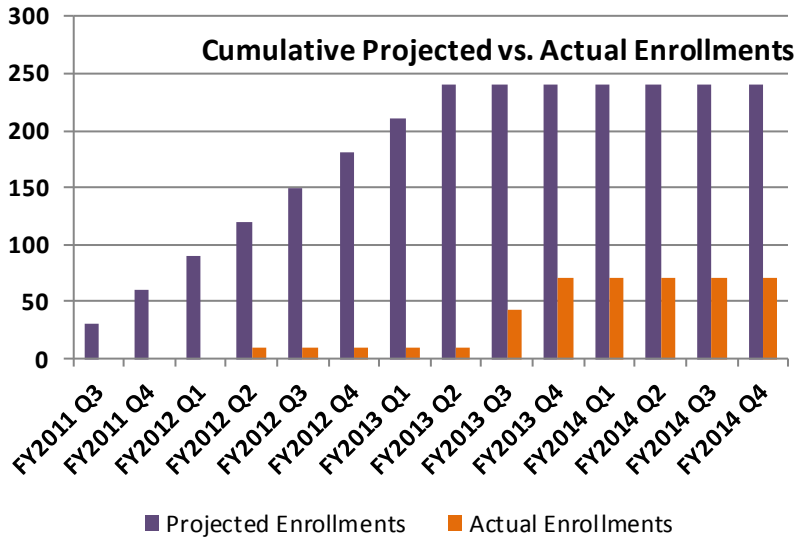
CID: OE0000474

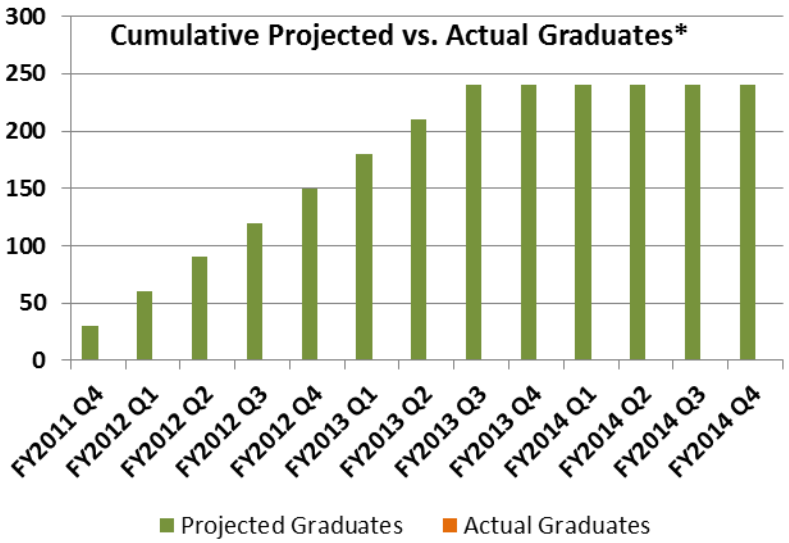
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Energy Sector Information Security Training	
Projected Number of Enrollments	240
Actual Number of Enrollments	71
Projected Number of Graduates	240
Actual Number of Graduates	0*

* The intent of the grant was to create courses, modules, and associated exercises and validate them for future delivery, thereby ensuring the success of the project. However, for an enrollee to be considered a graduate, the enrollee must have completed *all* modules and associated exercises, which no single enrollee was able to do.





Cuyahoga Community College

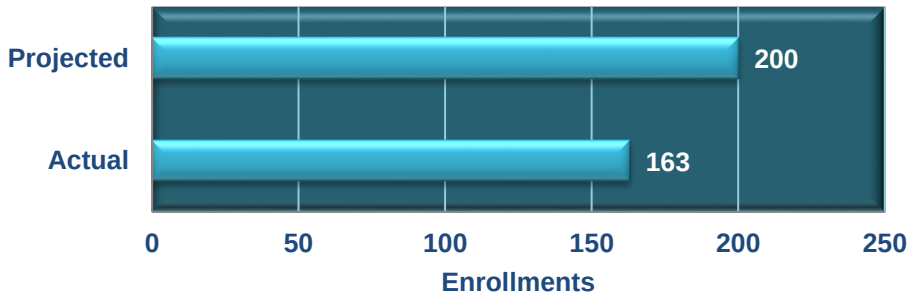
Increasing Competitiveness of the Electric Power Sector through Responsive Workforce Training Strategies

Project Description

Cuyahoga Community College and partner Cleveland Public Power (CPP) developed a curriculum to specifically build smart grid knowledge and fill job vacancies. The workforce training program included classroom, lab, worksite, and online instruction. Cuyahoga Community College used Designing A Curriculum (DACUM), a process that assesses job classifications, to analyze occupational skills and inform the design of the new and relevant smart grid curriculum. The DACUM analysis and curriculum were shared with other community colleges to aid in their workforce training.

Achievements

Two sets of training were developed—one for CPP workers and one for non-CPP employees. The coursework has been valuable in many ways. For instance, materials developed for a course on solar photovoltaic technologies were incorporated into Cuyahoga Community College's training program called Entry Level Solar Photovoltaic Certification, and training on power distribution and smart grid detailed relay switching is now a component of CPP's workforce development courses. Of the 163 students who participated in at least one of the trainings, 37 went on to attain a certification. These certifications included North American Board of Certified Energy Practitioners (NABCEP) solar certification, a Building Performance Institute (BPI) certification in energy auditing, and a certification in energy management. Moreover, a workshop on careers in energy technology was held for military veterans.



Success Story

After completing the NABCEP Solar Photovoltaic Prep Course and achieving her NABCEP certification, a graduate of the program was selected for an internship with Dovetail Solar, where she is now employed as an installer of solar equipment.

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PARTNERS

Cleveland Public Power

PROJECT DURATION

7/19/2010–9/30/2013

COST

Total Project Value
$844,259

DOE/Non-DOE Share
$749,204/$95,055

PROJECT LOCATION

Ohio

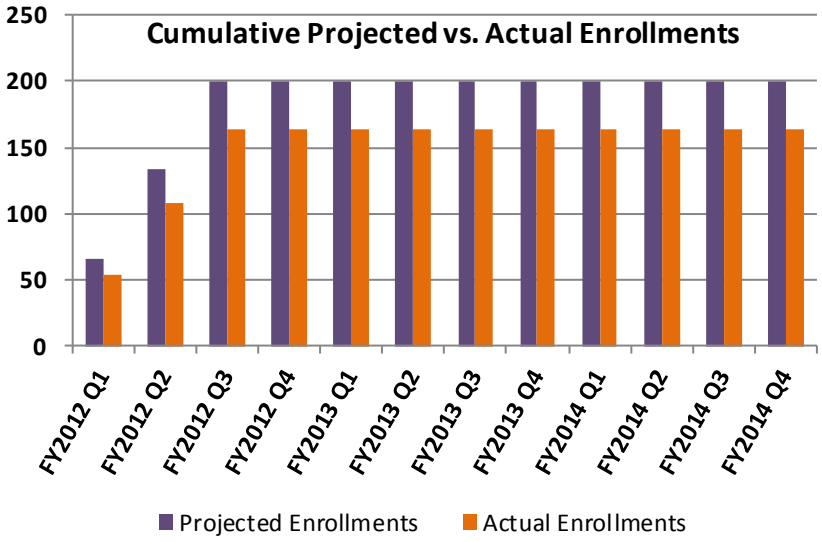
CID: OE0000448

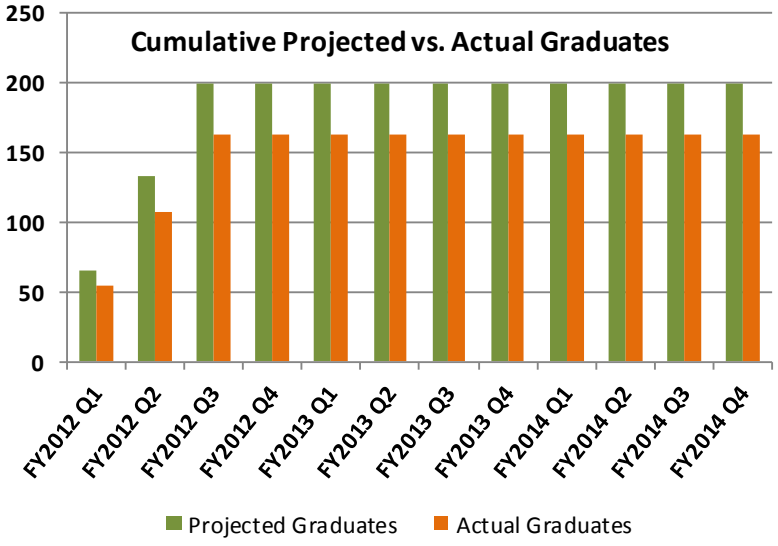
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

CUYAHOGA COMMUNITY COLLEGE

Metrics

Total Course Data	
Professional Development Program	
Projected Number of Enrollments	200
Actual Number of Enrollments	163
Projected Number of Graduates	200
Actual Number of Graduates	163





There were 37 individuals that proceeded to obtain a certification not awarded by this program, including the North American Board of Certified Energy Practitioners (NABCEP) solar certification, a Building Performance Institute (BPI) certification in energy auditing, and certification in energy management.

Duke Energy

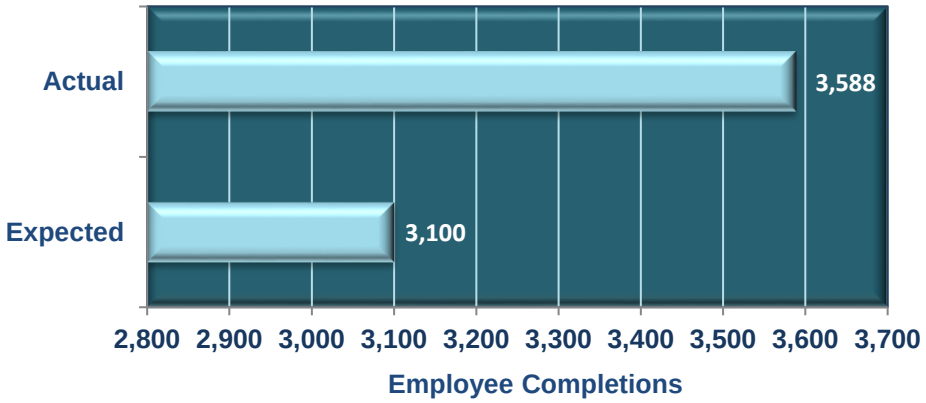
Smart Grid Workforce Training

Project Description

This project developed training materials for electrical operations and field safety skills for both Duke Energy employees and contract workers. In addition, informational packages were provided to local and state emergency management associations and to the crews from other utilities who come to Duke Energy's service territory to restore power after a major storm event. Training modules focused on the installation and operation of automated meters and their associated communication systems.

Achievements

Duke Energy offered eight smart grid courses to its workers in Ohio and Kentucky. Most of the workforce participated in them. The courses, which ranged in difficulty from introductory to advanced, covered such topics as distribution automation in specific substations and the implementation of automated metering infrastructure. Course outlines, presentation, speaker notes, and student handouts were developed for each course. The courses were included in a learning management system that enabled Duke Energy to account for student attendance and pass/fail rates. Students were interested in the subject matter, were highly engaged during classwork, and comprehended the lessons more quickly than expected, making the training especially efficient. Smart grid training continues at Duke Energy. When new employees are hired, they complete the curriculum, and as smart grid technologies are rolled out in Indiana, North Carolina, South Carolina, and Florida, Duke Energy plans to use the curriculum to educate its expanding workforce there.



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PARTNERS

None Listed

PROJECT DURATION

6/1/2010–5/31/2013

COST

Total Project Value
$805,202

DOE/Non-DOE Share
$402,601/$402,601

PROJECT LOCATIONS

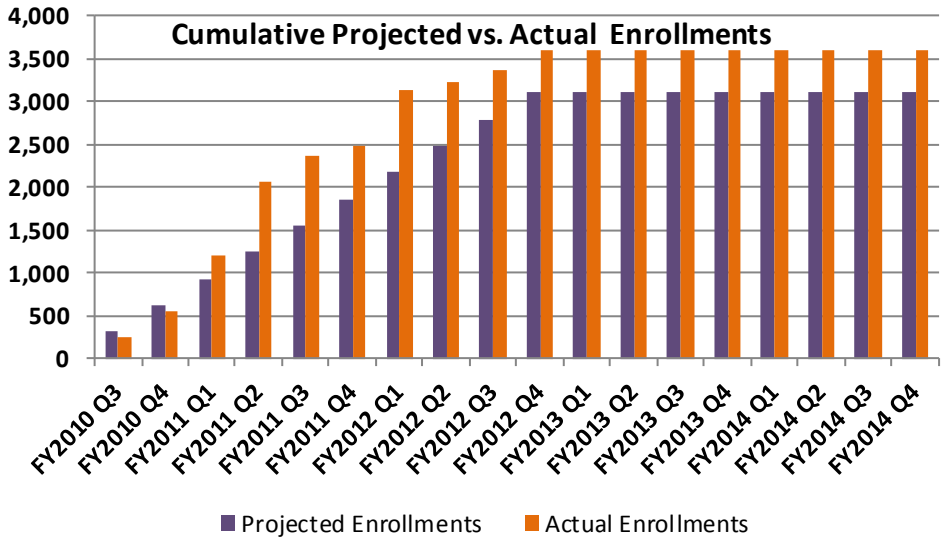
Ohio, Kentucky

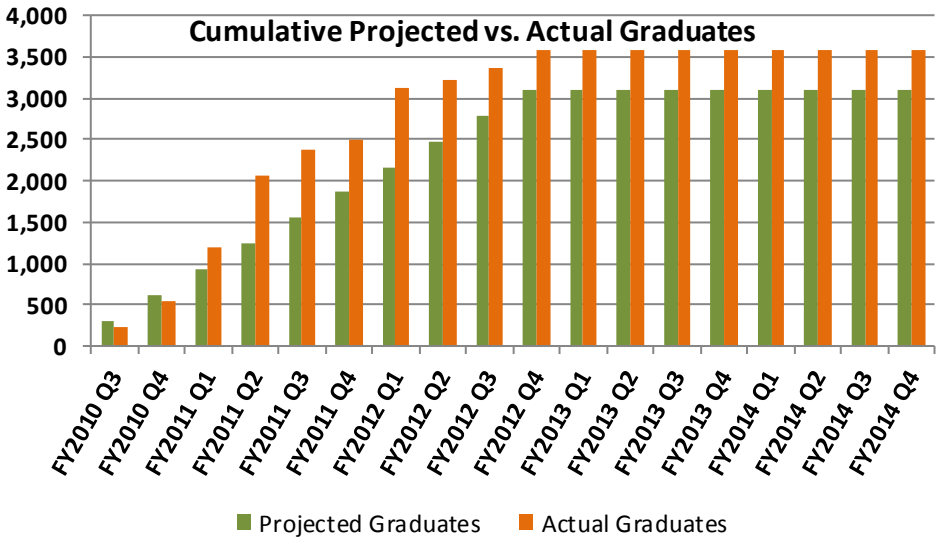
CID: OE0000399

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Utility Training Programs	
Projected Number of Enrollments	3,100
Actual Number of Enrollments	3,588
Projected Number of Graduates	3,100
Actual Number of Graduates	3,588





Florida Power & Light

Gateway to Power: Development of Innovative Strategic Electric Power, Renewable Energy, and Smart Grid Workforce

Project Description

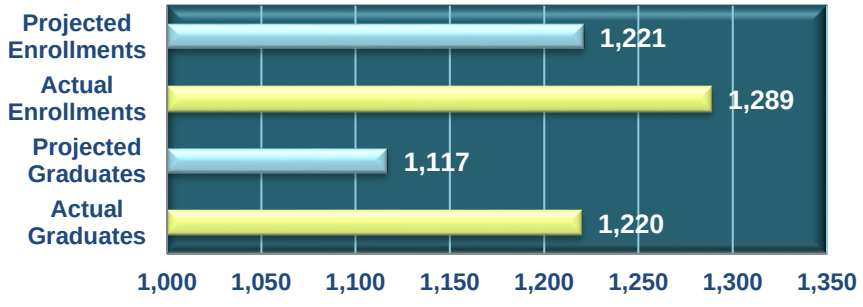
The Gateway to Power Consortium, led by Florida Power & Light and Smart Energy Grid Associates, delivers in-depth training in areas most relevant to the next-generation electric power workforce. These college- and university-level courses belong to one of four sectors: smart grid infrastructure, clean energy, regulatory and standards, or human factors. Students gain the knowledge and skills necessary to design, plan, construct, operate, and maintain a modern electricity delivery system.

Achievements

The numbers of students enrolling in and graduating from the program have outstripped expectations. The program is so popular that many courses have waitlists. Moreover, students consistently give the courses high marks during student evaluations. For instance, an Engineering Leadership I course that the Massachusetts Institute of Technology (MIT) offered received a rating of 5.8 (out of 7) on MIT's standard subject evaluation form, making it one of MIT's best-rated courses.

To ensure that graduates of the program are well prepared to enter the power-sector workforce, the project team developed multiple courses in each of the program's four sectors. The smart-grid-infrastructure sector, for example, includes courses on phasor measurement units and home area networks. The clean-energy sector focuses on alternative energy, including wind and solar. Courses in the regulatory-and-standards sector cover advanced power systems, cyber security, and greenhouse gases. Finally, the human-factors sector deals with engineering leadership, sustainability, and green business development.

Learning is not confined to the classroom. Interns and co-op students receive practical training at utility and industry sites. Students can also avail themselves of the program's alternative energy and sustainable building laboratories. Workshops and seminars at partner institutions—and short training courses offered by utility and industry partners—round out the program. By encompassing such a broad range of instruction, the program adheres to its three core themes: workforce training, workforce readiness, and transformative power sector workforce development.



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PARTNERS

Florida Atlantic University
Florida International University
Indian River State College
Massachusetts Institute of Technology
Palm Beach State College
Smart Energy Grid Associates
The State University of New York at Buffalo

PROJECT DURATION

8/1/2010–7/31/2013

COST

Total Project Value
$12,477,384

DOE/Non-DOE Share
$4,867,375/$7,610,009

PROJECT LOCATIONS

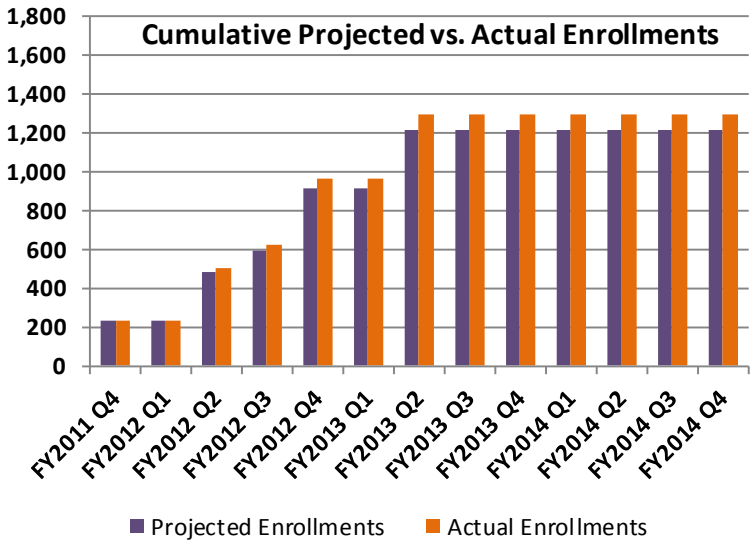
Florida, Massachusetts, New York

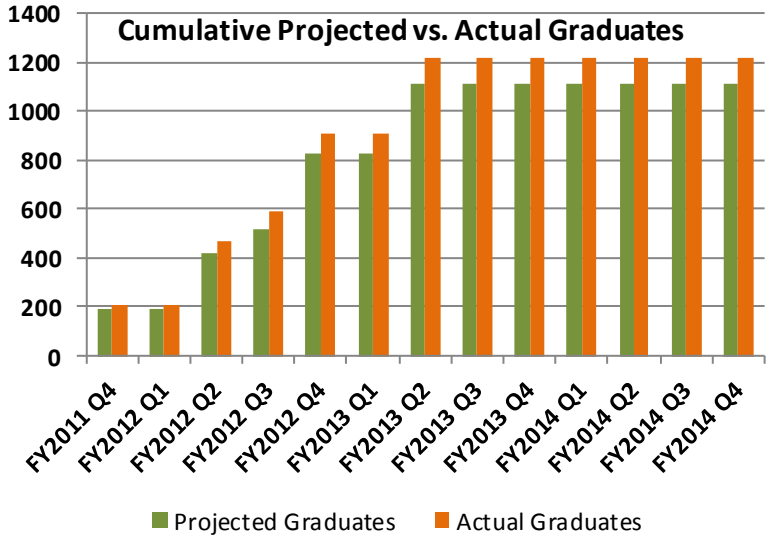
CID: OE0000435

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Utility Training Programs	
Projected Number of Enrollments	1,221
Actual Number of Enrollments	1,298
Projected Number of Graduates	1,117
Actual Number of Graduates	1,220





General Electric

Training for the Development of a Smart Grid Center of Excellence

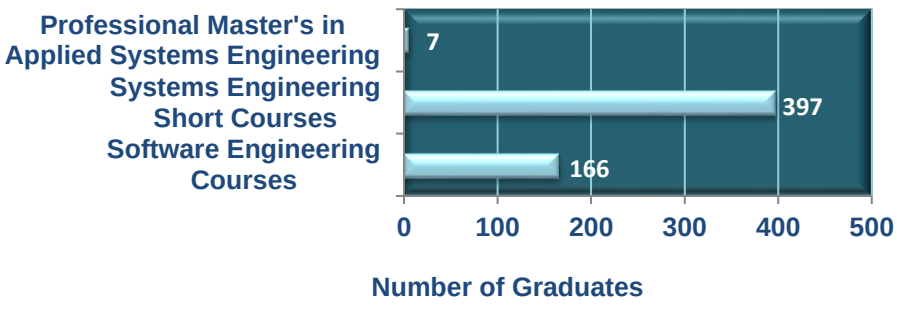
Project Description

General Electric (GE) provided the training necessary to establish the GE Smart Grid Center of Excellence, headquartered in Atlanta, GA (with satellite locations in Somersworth, NH, and Melbourne, FL). The engineers trained there attained the expertise needed to design and develop a smart grid. GE developed and taught the basic courses internally, with the advanced courses developed and delivered through an arrangement with the Georgia Institute of Technology. Advanced training was conducted in the areas of systems engineering and software engineering. The systems engineering training was offered as short, multi-day courses; these were followed by a professional master's program in applied systems engineering, which students could take after completing the short-course training. The software engineering training comprised multi-day courses.

Achievements

Over the 3-year program, 47 courses were taught: 27 in systems engineering, 10 in the software engineering short-course program, and 10 in the professional master's program. Because GE views these courses as successful, GE will continue to offer them to smart grid employees. Specifically, the master's-level program succeeded in giving students the skills they need to strategically plan projects and identify project risks. Students learned about the systems engineering process, modeling and simulation, design and analysis, and verification and validation, among other principles. As they completed the program, students considered current business problems, investigated money-saving engineering practices, and increased their capability to design and predict the behavior of complex systems.

The short courses in systems engineering were also beneficial, showing students how to manage projects, adhere to a budget and schedule, reduce project risks, and build systems that meet customers' needs. The software engineering courses also improved how quickly students delivered software products, which were delivered on schedule 93 percent of the time—the highest level the students had ever attained. Moreover, the number of software defects were reduced, and the engineers who completed the software engineering coursework reported feeling better about their work and the value of their products to customers.



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PARTNERS

None Listed

PROJECT DURATION

7/23/2010–7/22/2013

COST

Total Project Value
$1,277,161

DOE/Non-DOE Share
$634,312/$642,849

PROJECT LOCATION

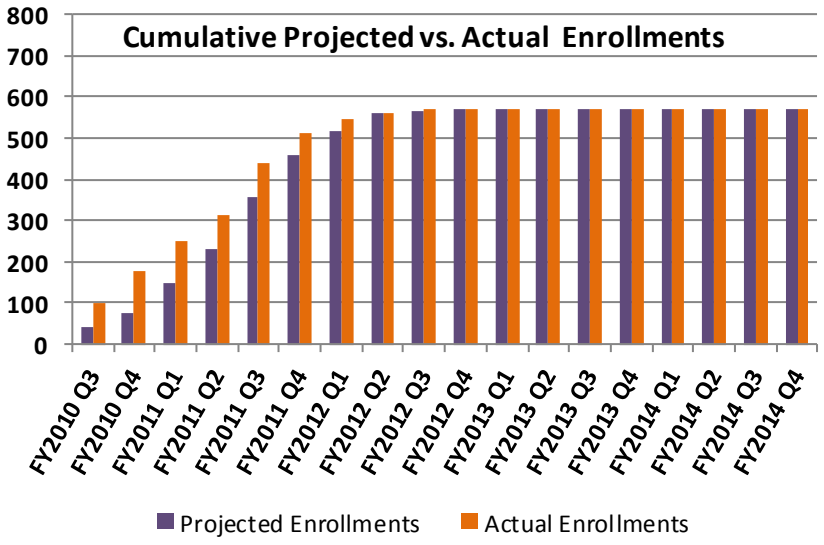
Georgia
New Hampshire
Florida

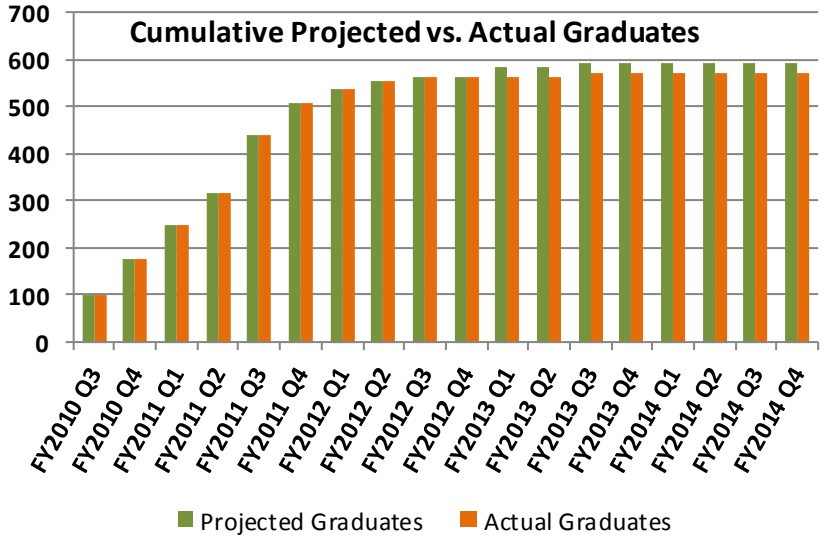
CID: OE0000499

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
Software Engineering Courses		**Systems Engineering Short Courses**		**Professional Masters in Applied Systems Engineering**	
Projected Number of Enrollments	166	Projected Number of Enrollments	397	Projected Number of Enrollments	7
Actual Number of Enrollments	166	Actual Number of Enrollments	397	Actual Number of Enrollments	7
Projected Number of Graduates	166	Projected Number of Graduates	418	Projected Number of Graduates	7
Actual Number of Graduates	166	Actual Number of Graduates	397	Actual Number of Graduates	7





Georgia Institute of Technology

Electrical Power Transmission and Distribution Connector Selection and Installation Training

Project Description

The National Electric Energy Testing, Research, and Applications Center (NEETRAC) of the Georgia Institute of Technology delivered training for line crews and engineers. NEETRAC scientists and engineers developed and conducted the training. Line crews learned how to install new technology connector products through classroom lectures and discussions that used NEETRAC failure investigation studies and hands-on practicum where students installed various accessories. Engineers learned about connector theory, how to specify connectors, and how to create quality systems that ensure the reliability of field installations.

Achievements

NEETRAC created six courses about overhead and underground electrical energy distribution connectors. Three of the courses were targeted at line crew members, and three were intended for engineers. All courses, regardless of their audience, covered overhead and underground connectors. They also covered general connector theory and connector basics, conductor preparation, reliability, safety, and quality systems. The engineer training was distinct for—among other things—its emphasis on standards and specifications, whereas the line-crew training was notable for the details it provided on installing particular types of connectors (such as compression, shear bolt, and mechanical connectors). NEETRAC dramatically exceeded its enrollment and graduation goals for both programs.

The training was offered at 13 sites within eight states across the country located in California, Georgia, New Jersey, North Carolina, Pennsylvania, South Carolina, Tennessee, and Wisconsin. A connector demonstrator that NEETRAC designed and built enhanced the coursework by giving instructors a vivid way to demonstrate that poorly installed connectors overheat. NEETRAC provided instructions for building the connector demonstrator, so that other training centers could make their own. NEETRAC also released the training materials for the six courses. The course information has been uploaded to the DOE Information Bridge.

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PARTNERS

None Listed

PROJECT DURATION

5/27/2010–5/27/2013

COST

Total Project Value
$714,570

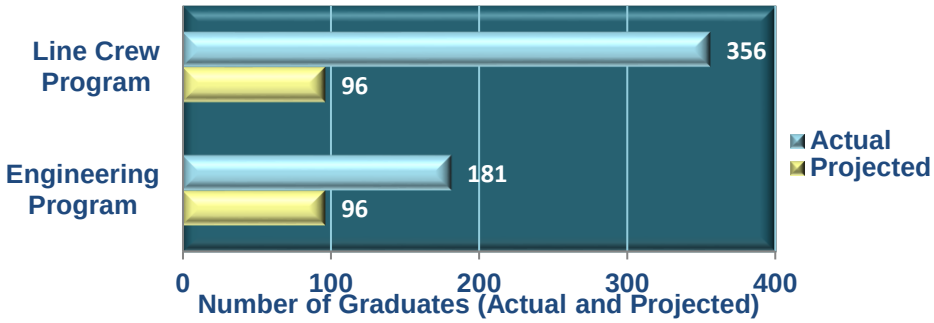
DOE/Non-DOE Share
$642,574/$71,996

PROJECT LOCATION

Georgia

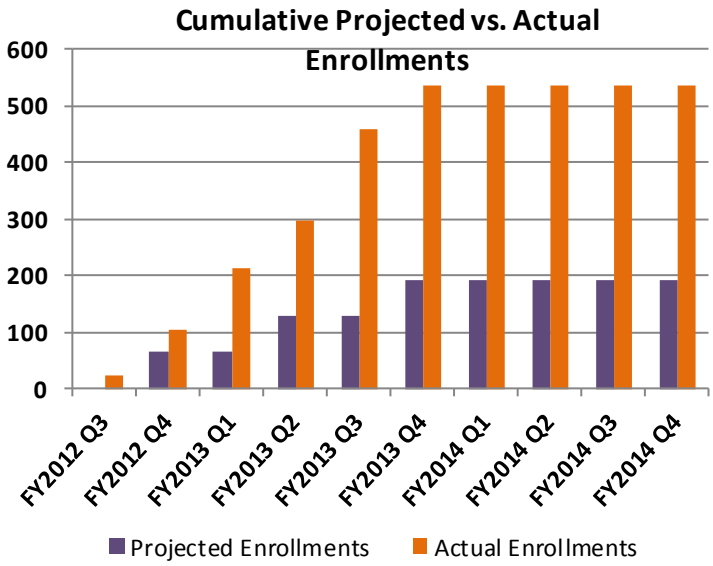
CID: OE0000461

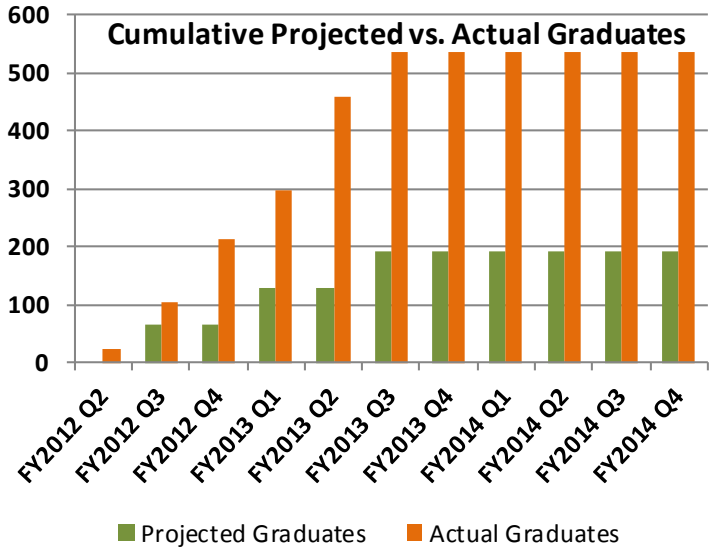
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability


Line Crew Program
356
96
Engineering Program
181
96
Actual
Projected
0
100
200
300
400
Number of Graduates (Actual and Projected)

Metrics

Total Course Data			
Line Crew Training (Trades)		**Engineering Training**	
Projected Number of Enrollments	96	Projected Number of Enrollments	96
Actual Number of Enrollments	356	Actual Number of Enrollments	181
Projected Number of Graduates	96	Projected Number of Graduates	96
Actual Number of Graduates	356	Actual Number of Graduates	181





The planned enrollments and graduates were exceeded because the training was delivered at 13 sites instead of the planned 10, and was supported by a number of companies throughout 8 states, who all provided facilities and students.

Glendale Community College
Southern California Utility Initiative

Project Description

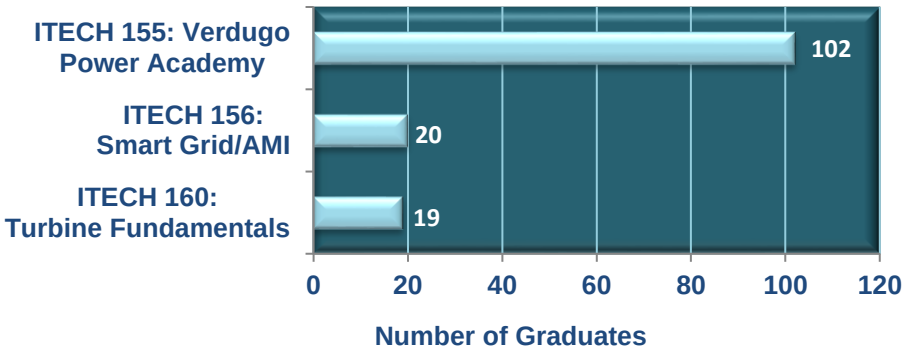
The Southern California Utility Initiative (SCUI) was a consortium formed to increase the number of graduates qualified to work in the electric industry. To accomplish this goal, existing training curricula and programs were expanded to meet the workforce needs of Southern California's electric utilities. SCUI provided regional Workforce Investment Board career centers to help workers acquire training and obtain good-paying jobs. Glendale Community College offered training as well. Collaborations with academic institutions ensured that the relevant training materials stayed current with new technologies and industry needs.

Achievements

An aging workforce and the deployment of new technologies (such as automated metering infrastructure [AMI] and renewable generation) prompted the project team to provide workforce development and training for the electric industry. In addition, the project team set out to address the problem of insufficient skill sets in newly hired employees. The project team developed three courses. The most successful of these, Verdugo Power Academy (ITECH 155), was offered for five semesters. Smart Grid/AMI (ITECH 156) and Wind Turbine Fundamentals (ITECH 160) were each offered for two semesters. The curricula were designed to prepare students for a wide spectrum of employment opportunities in the electric industry, not just careers as linemen.

Verdugo Power Academy covered such topics as overall safety considerations, pole-climbing skills, and the basic tools and materials involved in electric-utility work. Before students could enroll in Verdugo Power Academy, they had to meet certain math and English standards and complete an interview. These measures contributed to the course's low attrition rate.

Glendale Community College will continue to offer Verdugo Power Academy in the future. The course has been in high demand since its inception, and it is one of only four training programs that Southern California Edison has approved for its linemen. San Diego Gas and Electric also supported the program. (The other two courses that SCUI developed have been discontinued due to enrollment shortfalls.)



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California State University Northridge
Southern California Public Power Authority
Glendale Water and Power
Burbank Water and Power
Anaheim Public Utilities Department
Southbay Work Investment Board
Verdugo Work Investment Board
Foothill Work Investment Board

PROJECT DURATION

7/16/2010–7/15/2014

COST

Total Project Value
$844,396

DOE/Non-DOE Share
$750,000/$94,396

PROJECT LOCATION

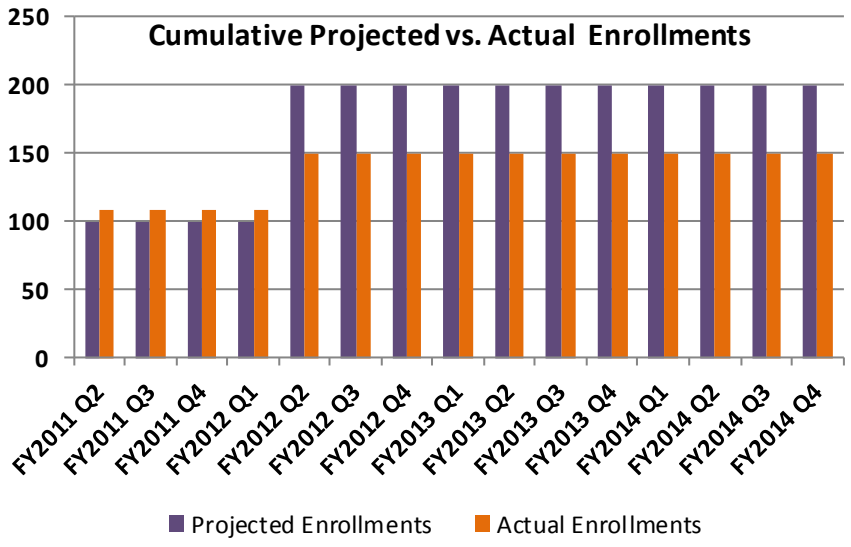
California

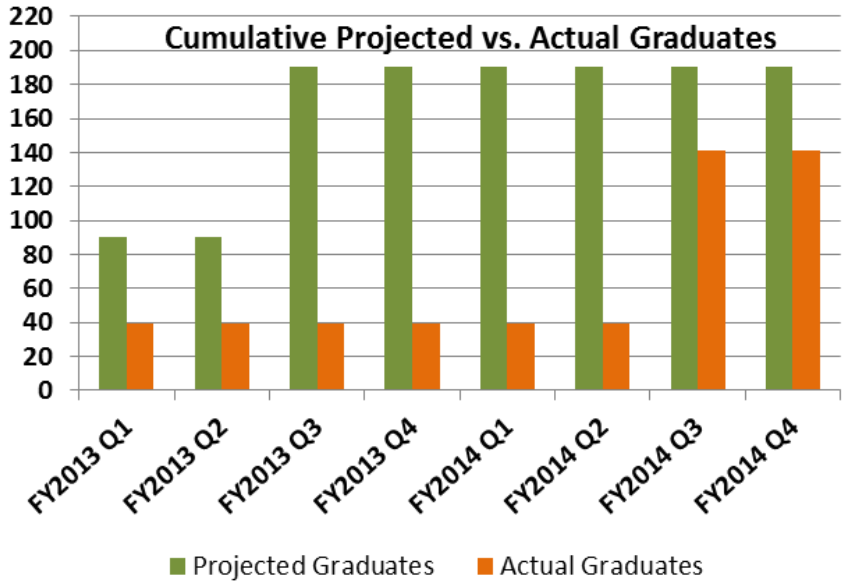
CID: OE0000490

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
ITECH 155 Verdugo Power Academy		ITECH Wind Turbine Technician		ITECH 156 AMI/Smart Grid	
Projected Number of Enrollments	100	Projected Number of Enrollments	50	Projected Number of Enrollments	50
Actual Number of Enrollments	108	Actual Number of Enrollments	20	Actual Number of Enrollments	22
Projected Number of Graduates	100	Projected Number of Graduates	45	Projected Number of Graduates	45
Actual Number of Graduates	102	Actual Number of Graduates	19	Actual Number of Graduates	20





The ITECH 156 Smart Grid/Advanced Metering Infrastructure and ITECH 160 Wind Turbine Fundamentals classes suffered from equipment delivery delays and low enrollments. As a result, it was determined these courses should be revised by paring down course content and lab exercises without diluting what the industry needs from graduates.

Illinois Institute of Technology

Smart Grid Education and Workforce Training Center

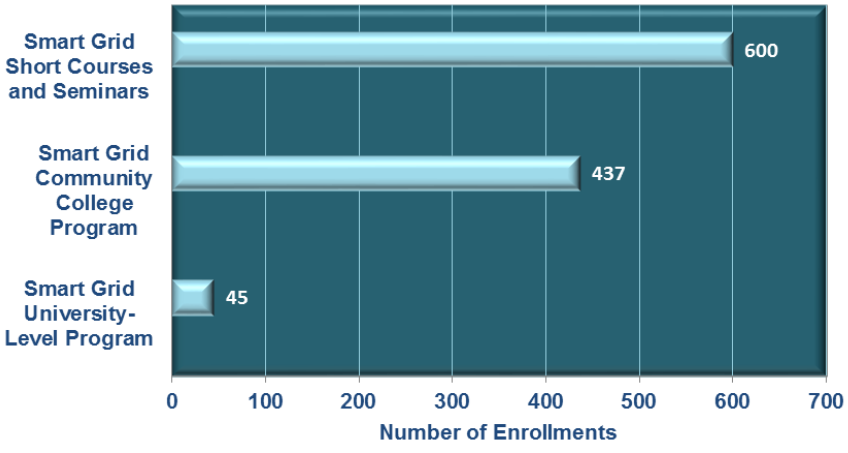
Project Description

The Illinois Institute of Technology (IIT) used its established power engineering education training center to provide smart grid education and training to diverse groups, such as power industry employees, students, instructors, and veterans. The Smart Grid Education and Workforce Training Center that IIT developed enabled educational options that include associate's, bachelor's, and graduate-level programs; certificate programs; short courses; and workshops. IIT equipped the Center with state-of-the-art software, including Areva T&D's Dispatcher Training System and Distribution Management System, and OSIsoft's PI System power grid monitoring and control software.

Achievements

The Center's construction, which began in March 2011, has since been completed. The project team identified gaps in workforce training after conducting an extensive survey. In addition, the project team worked with the Illinois Department of Employment Security to investigate veterans' employment in the energy sector.

Members of the project team developed courses that give an overview of the smart grid, discuss solar and wind energy, and cover such smart-grid-related topics as cyber security systems, signal processing, and demand response. Classes for more than 50 community college instructors were offered. The Center also selected two summer interns, whose project involved charting a cross-country route for an all-electric Tesla sedan. Twenty-five students in the Boeing Scholars Program used the Center, as did members of the Chicago Public Schools Pre-Engineering Program. IIT has begun coordinating with Lewis and Clark Community College and the utility company Ameren to train more than 4,000 Ameren employees on smart grid and advanced metering technologies. Furthermore, short courses on smart grid security, microgrid planning, and metering technology are in development.



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PARTNERS

State of Illinois
Areva T&D Inc.
Operation Green Jobs
Mississippi State University
OSIsoft LLC
Applied Professional Training
West Monroe Partners
Keyworks
McCoy Energy
Argonne National Laboratory

PROJECT DURATION

8/16/2010–8/13/2014

COST

Total Project Value
$12,632,794

DOE/Non-DOE Share
$4,999,999/$7,632,795

PROJECT LOCATION

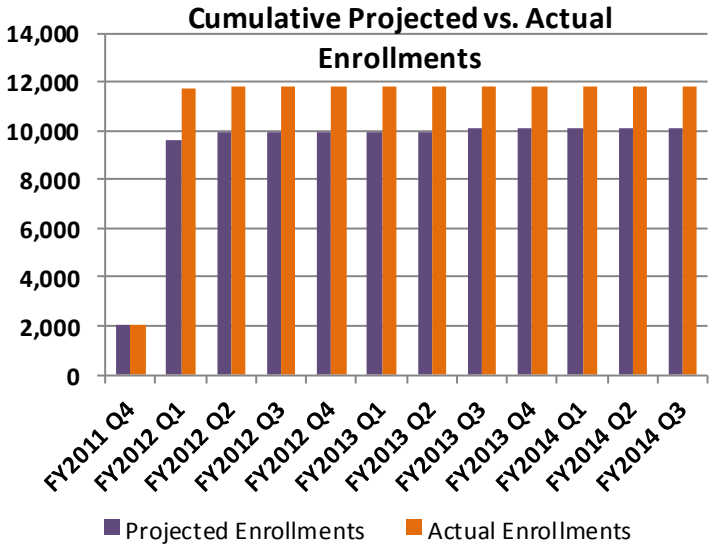
Illinois

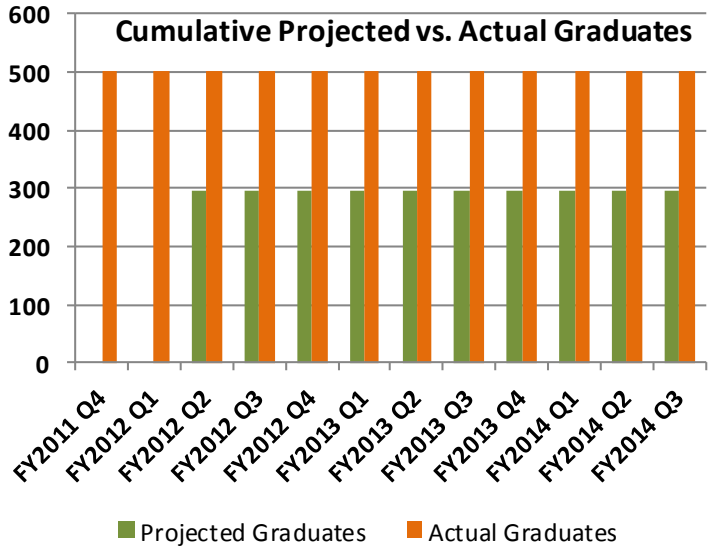
CID: OE0000449

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Smart Grid University Level Program		**Smart Grid Community College Program**	
Projected Number of Enrollments	50	Projected Number of Enrollments	600
Actual Number of Enrollments	45	Actual Number of Enrollments	437
Projected Number of Graduates	45	Projected Number of Graduates	250
Actual Number of Graduates	0*	Actual Number of Graduates	0*
Smart Grid Short Courses and Seminars Program		**Smart Grid K--12 Level Program**	
Projected Number of Enrollments	575	Projected Number of Enrollments	8,870
Actual Number of Enrollments	600	Actual Number of Enrollments	10,700
Projected Number of Graduates	0*	Projected Number of Graduates	500
Actual Number of Graduates	0*	Actual Number of Graduates	500





*Recipients were required to report graduates that occurred only during the project performance period of the grant. Courses in these programs were not offered until June 2013—with the period of performance ending in August 2013, there was no time to realize graduates.

Incremental Systems Corporation

Massive Real-time Simulations for Training Smart Grid Operators

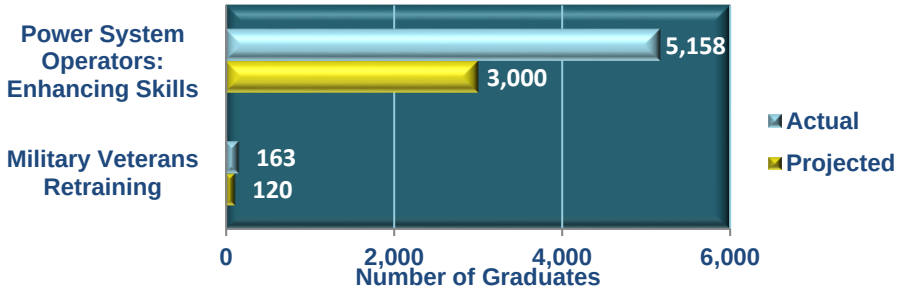
Project Description

Incremental Systems Corporation (IncSys) provided training with real-time simulations so that operators, engineers, and students could learn to prevent major power system events. With its PowerSimulator, IncSys could run drills using web-enabled simulations of complete interconnections. These simulations included smart grid technologies such as wind and solar farms, microgrids, and plug-in hybrid electric vehicles. PowerSimulator could also simulate cascading outages. The training showed how new smart grid systems, people, and processes can work together to benefit system reliability and reduce restoration times.

Achievements

By making real-time simulations possible on a large scale (even those involving hundreds of participants), IncSys gave trainees uniquely practical experience in staving off power failures. For example, when the California Electricity Training Advisory Committee ran training drills in 2013, system operators used PowerSimulator to simulate restoring their own systems after a blackout. Transmission operators benefitted from PowerSimulator, too, using it to run real-time simulations of their own bulk electric systems. For the first time, all transmission operators attending the training could engage with the simulator, rather than performing the exercise on paper.

The project also encompassed a program called Power4Vets, which focused on recruiting veterans for jobs in power system operations, training them, and securing jobs for them. Of the 163 veterans who completed the program, 59 transitioned directly from the military into power industry jobs, 36 entered the power industry workforce from other nonmilitary jobs, and 68 already employed in the power industry received training specific to power systems operations. In addition, 59 veterans earned their system operator certification through the North American Electric Reliability Corporation.



Success Story

Veterans who completed the retraining program have since landed jobs as system operators, transmission operators, balancing and interchange operators, solar technicians, and reliability coordinators, among other positions.

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PowerData Corporation; Pacific Gas and Electric; CenterPoint Energy; Grant County PUD; Southern Illinois Power Cooperative; SOS International; U.S. Embassy, Iraq; Centralia College, Clark College, Front Range Community College, Gonzaga University, Mississippi State University; Rensselaer Polytechnic Institute; Texas A&M University; Washington State University, Whatcom Community College

PROJECT DURATION

7/15/2010–7/14/2013

COST

Total Project Value
$8,356,283

DOE/Non-DOE Share
$3,600,000/$4,756,283

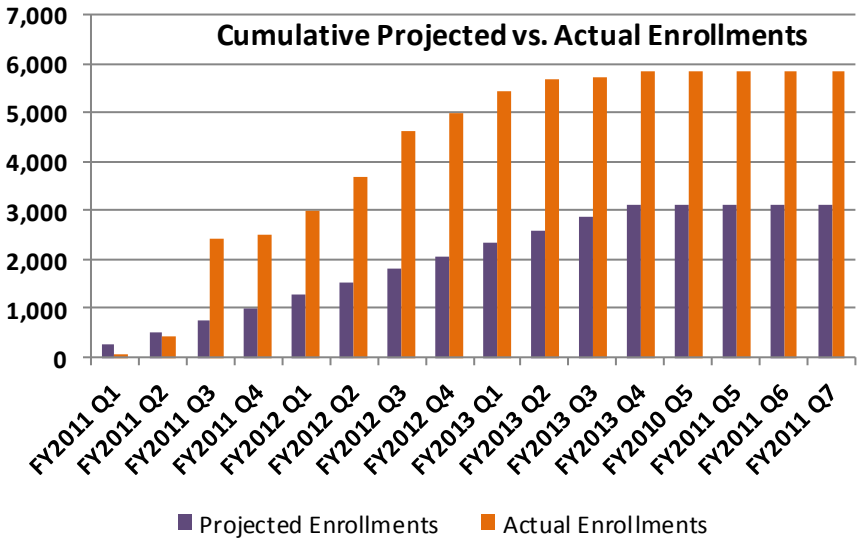
PROJECT LOCATION

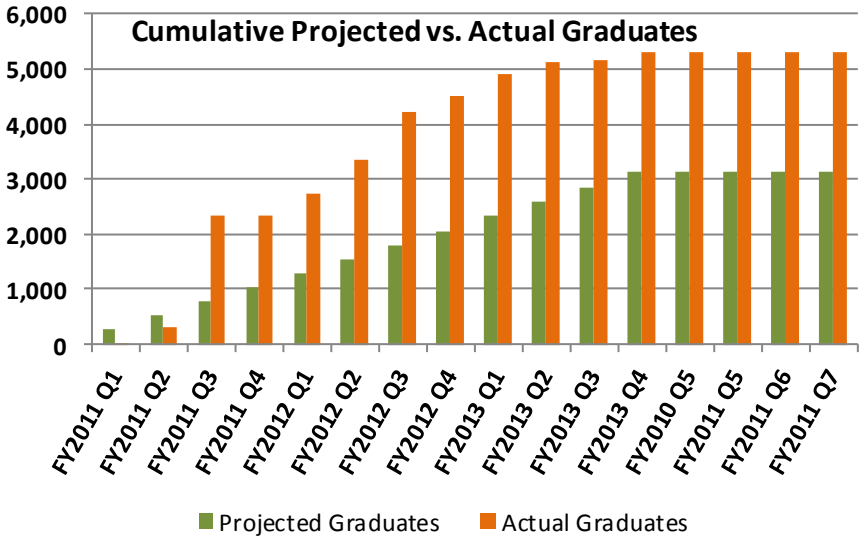
Washington
CID: OE0000488

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Military Veterans Retraining		**Power System Operators: Enhancing Skills**	
Projected Number of Enrollments	120	Projected Number of Enrollments	3,000
Actual Number of Enrollments	699	Actual Number of Enrollments	5,158
Projected Number of Graduates	120	Projected Number of Graduates	3,000
Actual Number of Graduates	163	Actual Number of Graduates	5,158





Iowa Valley Community College

Iowa Valley Collaborative Lineworker Training and Awareness Project

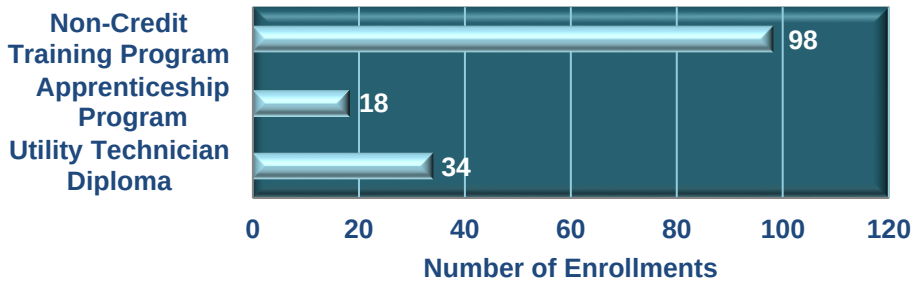
Project Description

Iowa Valley Community College (Iowa Valley) developed training strategies and increased public awareness of the lineworker career. Iowa Valley streamlined the apprenticeship system and developed a new pre-employment training program that culminates in a diploma. The reduction in entry-level positions was addressed by building awareness of the lineworker career among displaced workers from other sectors, underemployed individuals, and high school students.

Achievements

Iowa Valley's apprenticeship program utilized online modules to increase the program's reach, even into rural areas. In addition, Iowa Valley developed a non-credit lineworker training program. The 10-week program included instruction in math, computers, electricity, print reading, business skills, smart grid concepts, and general utility information. It also included hands-on safety training and gave students experience with climbing, using heavy equipment and hand tools, and welding. Students could also qualify for a climbing certification. Iowa Valley's new utility technician diploma provided another avenue for training. Enrollees in the year-long program first took classes that gave them an overview of the utility technician field. They then took training specific to electrical, gas, or mechanical maintenance, according to their preference. The diploma program has been a popular offering, necessitating a waitlist. Iowa Valley is currently developing a two-year program at the request, and with the support, of local utility companies.

To publicize its new programs, Iowa Valley advertised on the radio, over social media, at job fairs, and elsewhere. High enrollments in the non-credit training program and the utility technician diploma program demonstrate the marketing effort's success.



Success Story

One student who enrolled in the utility technician diploma program in the fall of 2012 landed an industry job before graduating, five found training-related employment after graduation, and two went on to pursue associate degrees.

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PARTNERS

Alliant Energy – Interstate Power and Light
MidAmerican Energy
Iowa Utility Workers Conference

PROJECT DURATION

7/20/2010–7/20/2013

COST

Total Project Value
$587,474

DOE/Non-DOE Share
$428,874/$158,600

PROJECT LOCATION

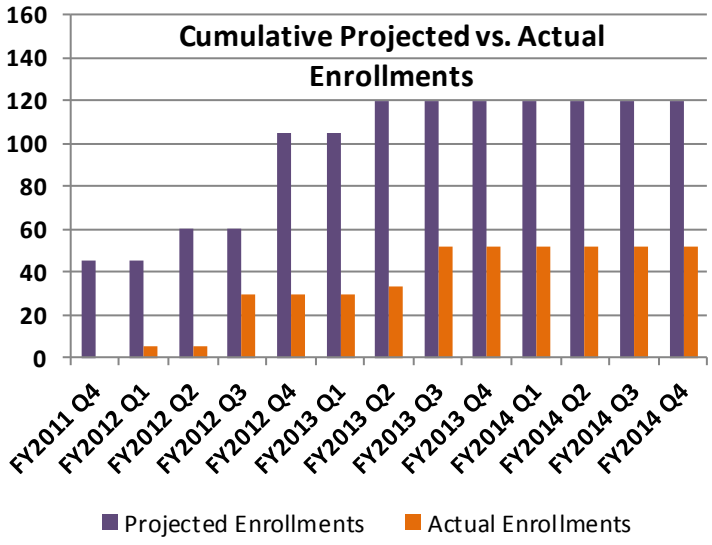
Iowa

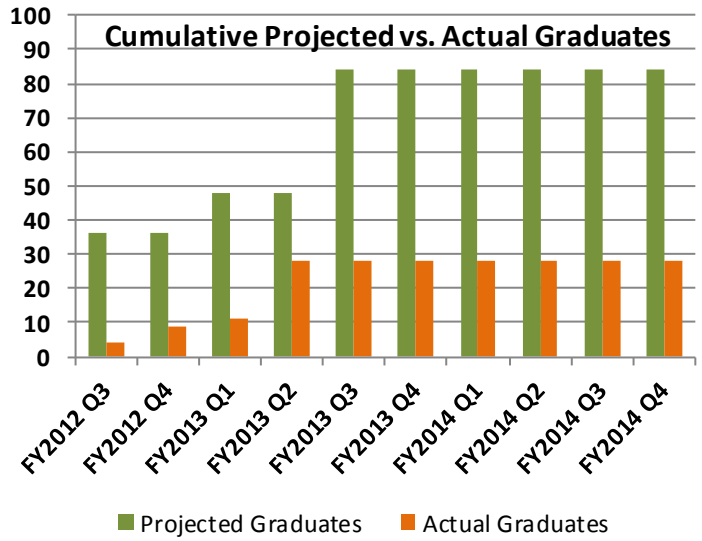
CID: OE0000438

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Utility Technician Diploma Program		**Apprenticeship Program**	
Projected Number of Enrollments	60	Projected Number of Enrollments	60
Actual Number of Enrollments	34	Actual Number of Enrollments	18
Projected Number of Graduates	48	Projected Number of Graduates	36
Actual Number of Graduates	14	Actual Number of Graduates	14





Recipients were required to report graduates that occurred only during the project performance period of the grant. The Apprenticeship Program enrollments did not meet initial projections due to fewer than expected job opportunities offered by the partner utility. The Utility Training Diploma Program enrollments did not meet projections during the grant period of performance due to faculty and equipment limitations causing project delays. However, interest was so strong in this program that a waitlist was initiated for the program and enrollments were expected to be strong in the future.

Ivy Tech Community College
Crossroads SmartGrid Training Program

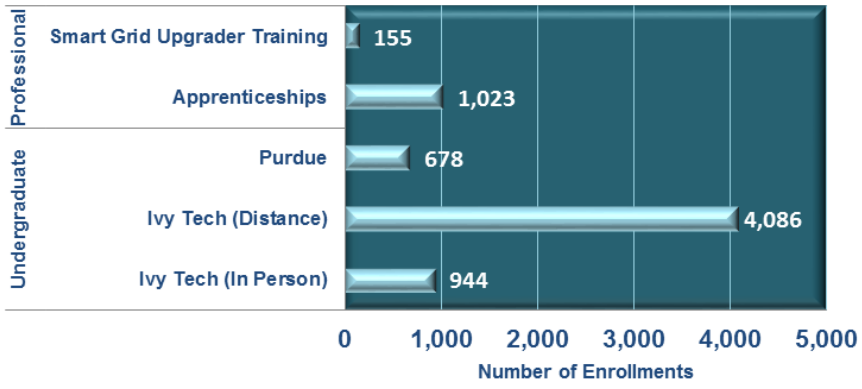
Project Description

In collaboration with Purdue University (Purdue), Ivy Tech Community College (Ivy Tech) developed courses to minimize the education-workforce gap in Indiana's electric energy sector. Educational areas included systems management and security; information technology and power systems engineering; and the training of line workers, technicians, and mechanics.

Achievements

Ivy Tech and Purdue created or modified 59 courses that dealt with the smart grid. In doing so, they surpassed their initial goal of developing or modifying just 33 courses. Of the 59 courses that made up this project, 55 were credit-bearing, and 4 were non-credit courses targeted at incumbent industry professionals. Online delivery enhanced the availability of 12 credit-bearing courses and 2 non-credit courses. By the end of the project, the online courses had garnered more than 20,000 enrollments by an estimated 4,000 students.

Representatives from the electric power sector provided input that drove course development. For example, as a result of their input, the coursework emphasized information systems, information technology, and cybersecurity—fields where job opportunities abound. Courses that Ivy Tech and Purdue offered ranged from introductions to circuit analysis, microcontrollers, and renewable energy, to more advanced courses in building automation, cryptography, and cyber terrorism. Purdue used its Integrated Smart Energy Technology Lab to provide cutting-edge learning and research opportunities for students who wanted to learn about integrating renewable resources into the grid. Moreover, Purdue students participated in research projects with the U.S. Military Academy, General Electric, and EnerDel to investigate smart grid, microgrid, and battery applications. For its part, Ivy Tech invested over $1.2 million in laboratory equipment. This equipment included NEXTLAB+, a system designed to train students in cybersecurity. In these ways, Ivy Tech and Purdue gave students highly practical training and strove to inspire their interest in energy-sector careers.



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PARTNERS

Purdue University

PROJECT DURATION

7/1/2010–9/30/2013

COST

Total Project Value
$9,663,237

DOE/Non-DOE Share
$4,699,353/$4,963,884

PROJECT LOCATION

Indiana

CID: OE0000469

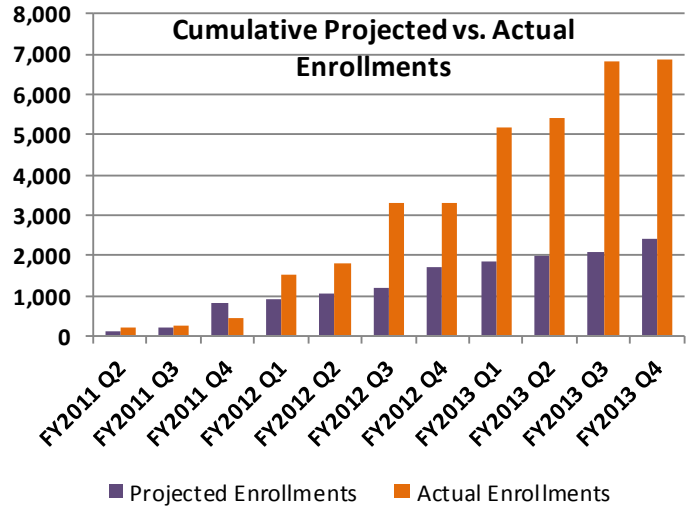
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

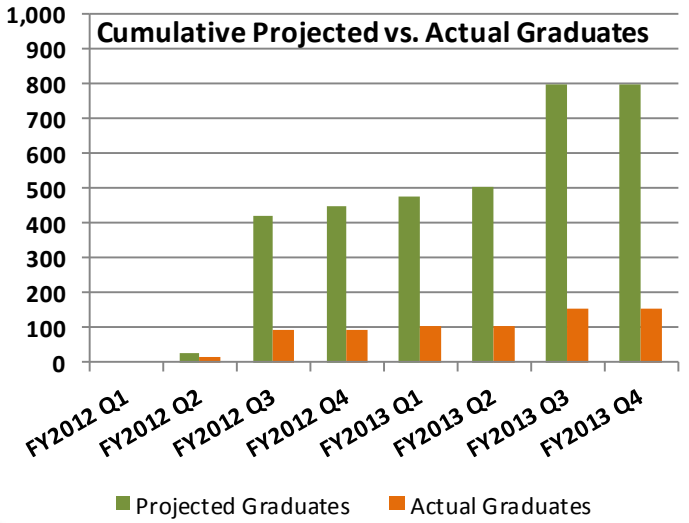
Metrics

Total Course Data			
Ivy Tech: Undergraduate		**Ivy Tech: Undergraduate Distance Education**	
Projected Number of Enrollments	560	Projected Number of Enrollments	300
Actual Number of Enrollments	944	Actual Number of Enrollments	4,086
Projected Number of Graduates	392	Projected Number of Graduates	0*
Actual Number of Graduates	0*	Actual Number of Graduates	0*
Purdue Courses		**Ivy Tech: Smart Grid Upgrader Training**	
Projected Number of Enrollments	360	Projected Number of Enrollments	236
Actual Number of Enrollments	678	Actual Number of Enrollments	155
Projected Number of Graduates	240	Projected Number of Graduates	165
Actual Number of Graduates	0*	Actual Number of Graduates	155

*Recipients were required to report projected and actual graduates that occurred only during the project performance period of the grant. For some of these programs, graduates were not expected to be realized during the performance period.

Apprenticeships/Journeyman	
Projected Number of Enrollments	943
Actual Number of Enrollments	1,023
Projected Number of Graduates	0*
Actual Number of Graduates	0*





In the Distance Education program, Ivy Tech had more than 20,000 enrollments over 5 courses, with an estimated 4,086 individual students taking courses.

The Project's success was the result of listening to industry. The initial goal of 2,399 student seats filled was established without the benefit of industry input. Once industry was engaged and described how they wanted education/training delivered, the Project had to then rapidly adjust from the original planning to a new more elastic format. Because Smart Grid topics are relevant to a range of courses, this allowed the creation and modification of a large number (59) of courses for Smart Grid topics and modules. This expanded inventory of courses allowed a larger segment of potential student populations' exposure to Smart Grid concepts in areas not traditionally believed to be 'relevant' to the utility industry. These areas can include Information Technology & Systems, Cyber Security/Information Assurance which are crucial to utilities as they implement and deploy Smart Grid across their systems.

Key Training Corporation

Grid Training Modernization Project

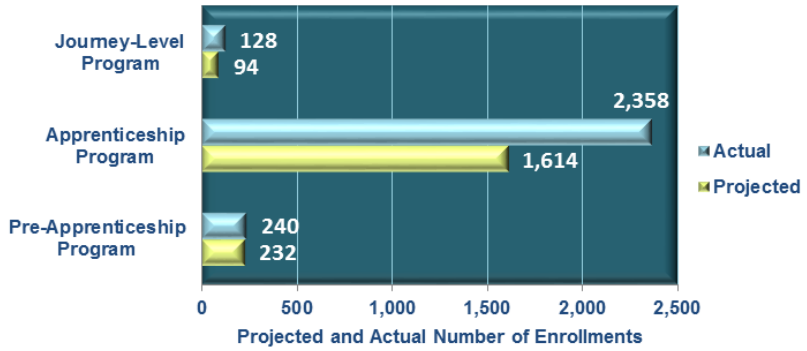
Project Description

Over three years, Northwest Lineman College worked with manufacturers, utilities, and construction companies to develop training strategies, programs, and delivery methods for the workers who would install, maintain, and operate the smart grid. Target groups for this project included lineworkers, substation technicians, system operators, meter technicians, and plant operators. As the single largest trainer of electrical lineworkers in the country, Northwest Lineman College could leverage its existing infrastructure, staffing, curriculum, and utility-customer base to rapidly develop and disseminate smart grid training programs nationwide.

Achievements

The project addressed gaps in education for trainees pursuing careers as electrical lineworkers, substation technicians, system operators, meter technicians, and transmission technicians. Training programs at the pre-apprenticeship, apprenticeship, and journey levels were developed and made available across the United States. Of particular note is the training module for prospective substation technicians, which is one of the first curricula of its kind. The training programs encompassed distance education in addition to hands-on learning at Northwest Lineman College's three electrical equipment labs. The labs house voltage regulators, automated switches, and sectionalizers—among other devices—and give trainees experience with a diversity of smart grid equipment in one setting. Instructional videos that discussed the labs' equipment were produced and uploaded to linemanchannel.com, at employers' request.

The project team strove to meet employers' needs in other ways as well. For instance, employers needed lineworkers to understand a variety of smart grid devices on a distribution line, rather than solely smart meters in isolation, so the project team ensured that training programs reflected this requirement. Moreover, the project team rescheduled the launch of its transmission-technical program so that trainees would be prepared to fill vacancies associated with critical transmission projects. Enrollments in programs at all levels exceeded expectations. The apprenticeship programs were especially successful in this regard. The number of actual enrollments was more than 40 percent higher than expected because the project team launched a new curriculum in March 2012.



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PARTNERS

Vaughn Industries
Northeast Public Power Association
Georgia EMC
Great Southwestern Construction
Laclede Electric Cooperative
Navopache Electric Cooperative

PROJECT DURATION

7/23/2010–7/22/2013

COST

Total Project Value
$2,217,938

DOE/Non-DOE Share
$750,000/$1,467,938

PROJECT LOCATIONS

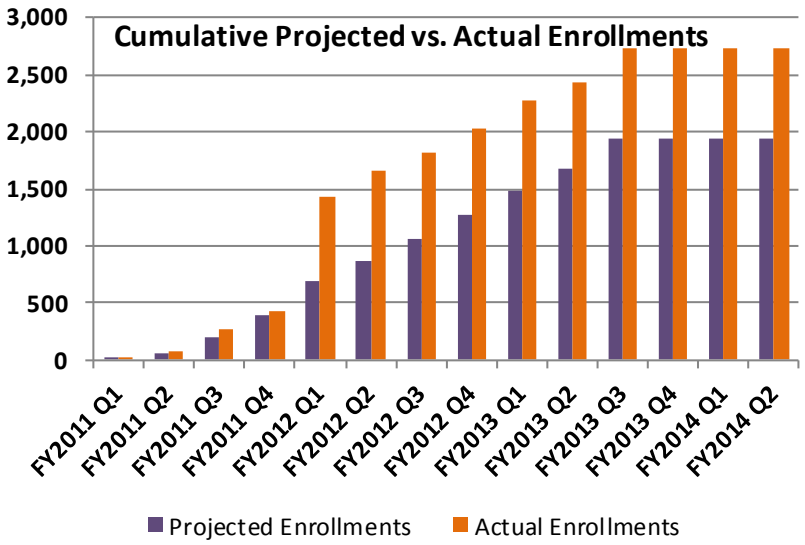
California, Idaho, Texas

CID: OE0000439

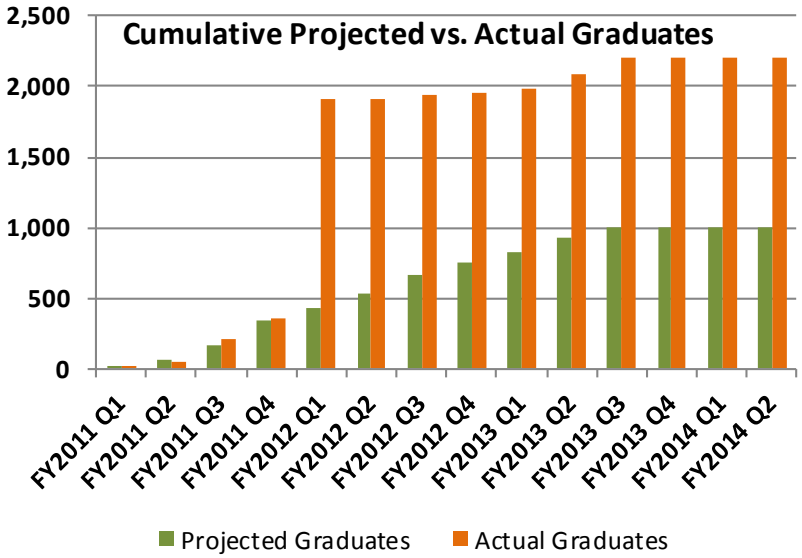
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
Pre-Apprenticeship Program		**Apprenticeship Program**		**Professional Development Program**	
Projected Number of Enrollments	232	Projected Number of Enrollments	1,614	Projected Number of Enrollments	94
Actual Number of Enrollments	240	Actual Number of Enrollments	2,358	Actual Number of Enrollments	128
Projected Number of Graduates	200	Projected Number of Graduates	725	Projected Number of Graduates	79
Actual Number of Graduates	169	Actual Number of Graduates	1,902	Actual Number of Graduates	128



This data reflects the number of individual students that went through the program.



Lehigh University

Keystone Smart Grid Fellowship Program

Project Description

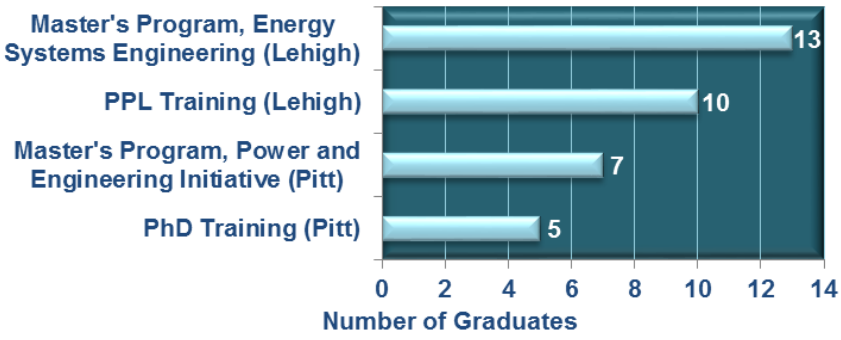
Lehigh University (Lehigh) and the University of Pittsburgh (Pitt) established a network of smart grid "fellows" to train a new smart grid workforce. Lehigh modified its current master's programs to include a smart grid concentration. Pitt enhanced its electric power and energy engineering education programs at both the undergraduate and graduate levels. In addition, corporate partnerships and government funding provided opportunities for collaborative research into topics relevant to the smart grid.

Achievements

Numerous students who completed Lehigh's or Pitt's new programs of study have attained full-time employment with the PJM Interconnection, Voith Hydro, ISM Solar Solutions, Colonial Electric Supply, Siemens Energy, and other companies in the energy industry. The coursework the students completed gave them the background knowledge they needed to excel in their new positions. In particular, Lehigh launched a course on communications and networking for smart grids. At Pitt, graduate-level courses were offered in renewable and alternative energy systems, smart grid technologies and applications, sustainable modeling, and protective relaying and substation automation. Moreover, Pitt offered two new undergraduate courses: Electric Distribution Engineering and Smart Grids, and Electrical Power Transmission, Distribution, and Grid Technologies. Other students already employed with PPL Corporation completed a new course—Transmission and Distribution/Smart Grid—that PPL Corporation offered as a result of this project.

Pitt, furthermore, installed and commissioned an electric power systems laboratory, which accommodates both research and education activities. The lab allows faculty and graduate students to investigate microgrids, power electronic devices and converters, renewable energy systems, controls and communications, automation and relaying, and other emerging electric power technology areas.

The project's success is evidenced by the more than 30 related papers that have been published in such venues as *IEEE Transactions on Smart Grid*, *IEEE Transactions on Power Electronics*, and *IEEE Power & Energy Magazine*.



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PARTNERS

University of Pittsburgh

PROJECT DURATION

7/30/2010–6/30/2015

COST

Total Project Value
$987,552

DOE/Non-DOE Share
$748,058/$239,494

PROJECT LOCATION

Pennsylvania

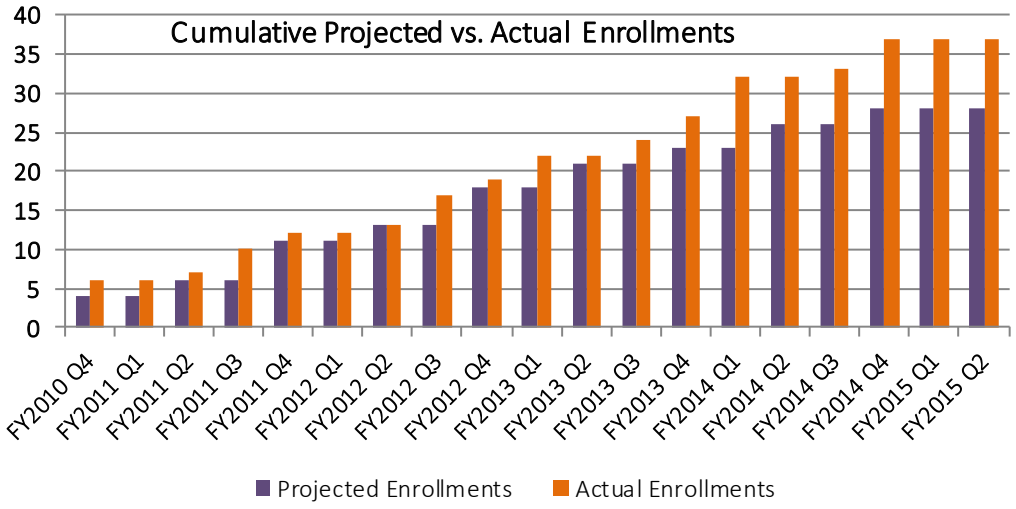
CID: OE0000428

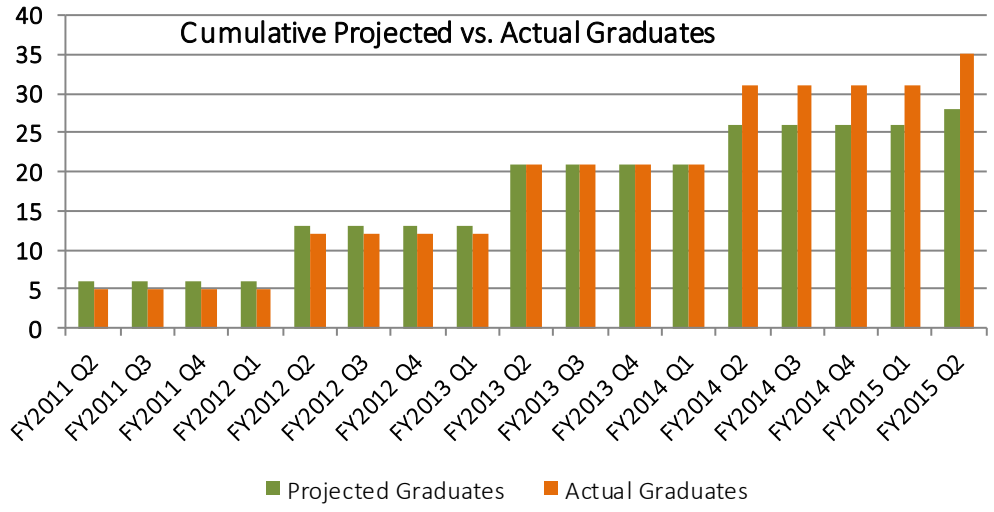
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
PhD Training (Pitt)		**MS Program, Engineering Energy Systems (Lehigh)**	
Projected Number of Enrollments	0*	Projected Number of Enrollments	12
Actual Number of Enrollments	6	Actual Number of Enrollments	14
Projected Number of Graduates	0*	Projected Number of Graduates	12
Actual Number of Graduates	5	Actual Number of Graduates	13
MS Program, Power & Engineering Initiative (Pitt)		**PPL Training (Lehigh)**	
Projected Number of Enrollments	6	Projected Number of Enrollments	10
Actual Number of Enrollments	7	Actual Number of Enrollments	10
Projected Number of Graduates	6	Projected Number of Graduates	10
Actual Number of Graduates	7	Actual Number of Graduates	10

*Considering the advanced nature of the PhD training program, enrollments and graduates were not anticipated at the beginning of the project performance period of the grant.





Michigan Strategic Fund

Michigan Electric Power Workforce Training Strategy

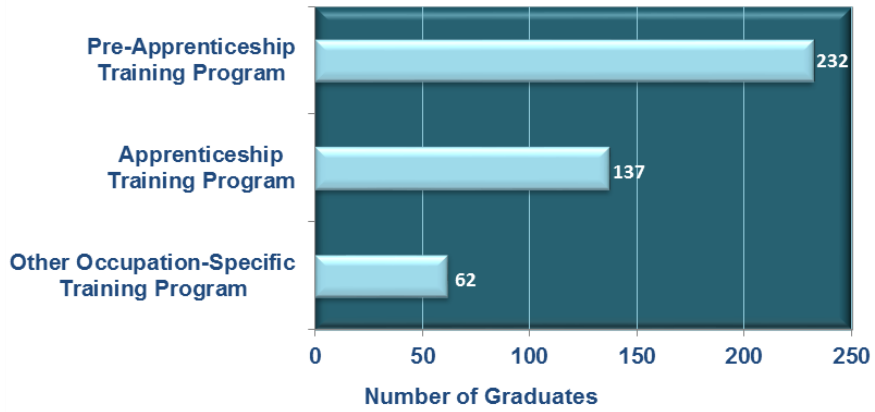
Project Description

The Michigan Strategic Fund (formerly the Michigan Department of Energy, Labor, and Economic Growth) established the Michigan Utility Workforce Development Consortium. The consortium brought together more than 25 partners from industry, labor, associations, and academia to find ways to meet the industry's workforce needs. High-tech training in the power sector was offered through community colleges and utility/union training trusts, including pre-apprenticeship, apprenticeship, and incumbent worker training. Michigan Works! partners helped to identify eligible participants and direct them toward the appropriate training pathway.

Achievements

The project team developed and offered training that focused on five occupational areas, which were chosen based on industry recommendations: electrical line technicians, substation and engineering technicians, substation operators, electrical maintenance, and advanced metering infrastructure technicians. The training also accommodated industry's changing needs by expanding to encompass training in cogeneration power plant operation and maintenance, and smart grid component manufacturing. As a result of the training delivered by the project team, 154 individuals have attained employment in the energy industry, and 236 individuals have retained their existing employment. In the case of the Pre-Apprentice Lineworker Training program, a hiring pool was established in support of Consumers Energy and Detroit Edison Energy.

The project team took several measures to recruit trainees. For instance, the team held a Line Technician Recruiting Expo designed to help jobseekers determine if a utility career was right for them. The Expo also addressed the dearth of lineworker job applicants and the high failure rate for pole climbing and Construction and Skilled Trades testing. The team, moreover, published a video about line technicians; subsequently, waitlists for the line technician training programs became necessary. Such high demand is a sign of the project's success.



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PARTNERS

Consumers Energy
Detroit Edison Energy
Michigan Works! Agencies

PROJECT DURATION

7/30/2010–7/29/2014

COST

Total Project Value
$11,186,156

DOE/Non-DOE Share
$4,388,025/$6,798,131

PROJECT LOCATION

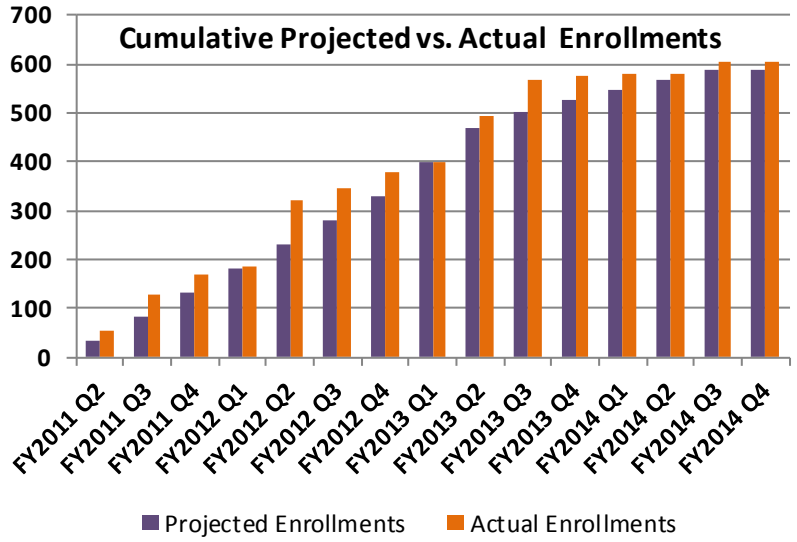
Michigan

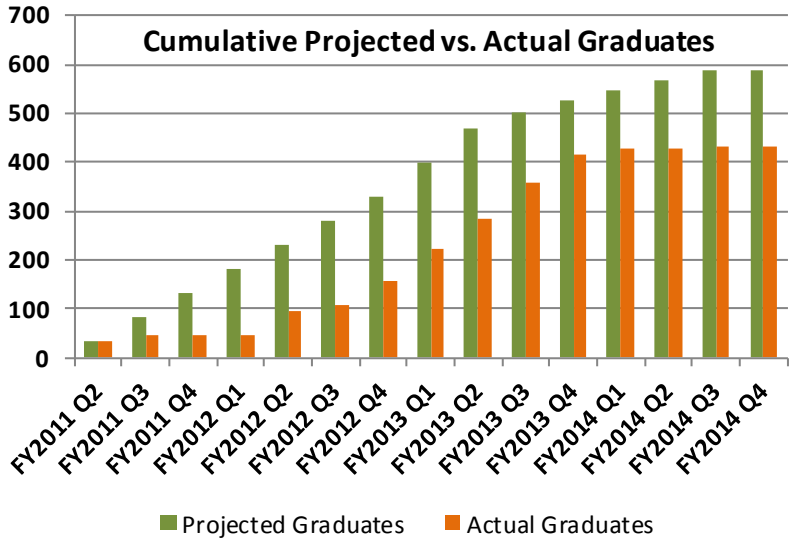
CID: OE0000443

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
Pre-Apprenticeship Training Program		**Other Occupation Specific Training Program**		**Apprenticeship Training Program**	
Projected Number of Enrollments	306	Projected Number of Enrollments	144	Projected Number of Enrollments	138
Actual Number of Enrollments	361	Actual Number of Enrollments	85	Actual Number of Enrollments	159
Projected Number of Graduates	306	Projected Number of Graduates	144	Projected Number of Graduates	138
Actual Number of Graduates	232	Actual Number of Graduates	62	Actual Number of Graduates	137





Mississippi Gulf Coast Community College
Workforce Development for the Electric Power Sector

Project Description

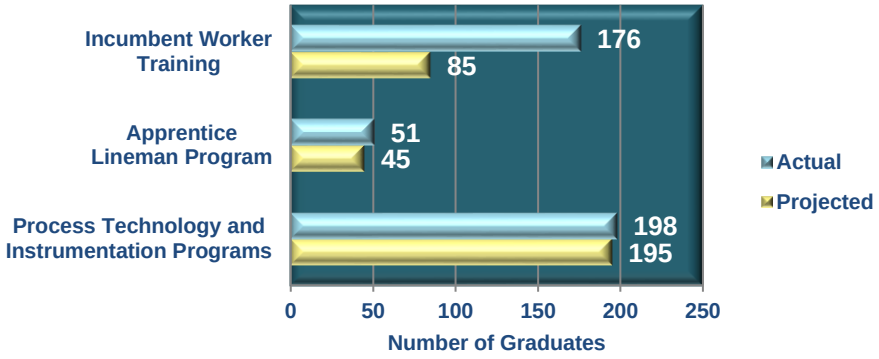
Mississippi Gulf Coast Community College (MGC) provided training for apprentice linemen, incumbent linemen, and process operations and instrumentation specialists. Students interacted with clean energy industry personnel via courses, internships with industry and government laboratories, and outreach with communities. Courses and training were conducted in traditional classroom, hybrid, and online formats with evening and weekend training scheduled for incumbent workers.

Achievements

To help educators prepare their students for a place in the electric power industry, MGC offered curriculum development training to seven of its faculty members (three more than originally planned). In addition, MGC hosted smart grid seminars that attracted 246 post-secondary and secondary instructors, more than double the expected attendance. The seminars focused on developing a workforce equipped to interact with smart grid technologies and alternative energy sources.

After developing six courses on the smart grid and emerging technologies, MGC integrated them into three energy programs: Process Operation Technology, Instrumentation, and Apprentice Lineman Training. MCG also installed nearly $450,000 of smart grid technologies and simulation equipment in its labs. As a result, MCG could educate a wide variety of students. Some students earned an associate's degree, while others completed linemen apprenticeships. Still others, who were already employed as linemen, upgraded their knowledge of the smart grid and earned continuing education units.

Over the course of the project, MCG saw a 40 percent increase in the number of women enrolled in its energy programs, outstripping MCG's original goal of a 20 percent increase. Furthermore, enrollments in the energy programs overall rose by 46 percent; this increase, likewise, beat the 20-percent projection.



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PROJECT DURATION

8/1/2010–7/31/2013

COST

Total Project Value
$1,369,229

DOE/Non-DOE Share
$713,830/$655,399

PROJECT LOCATION

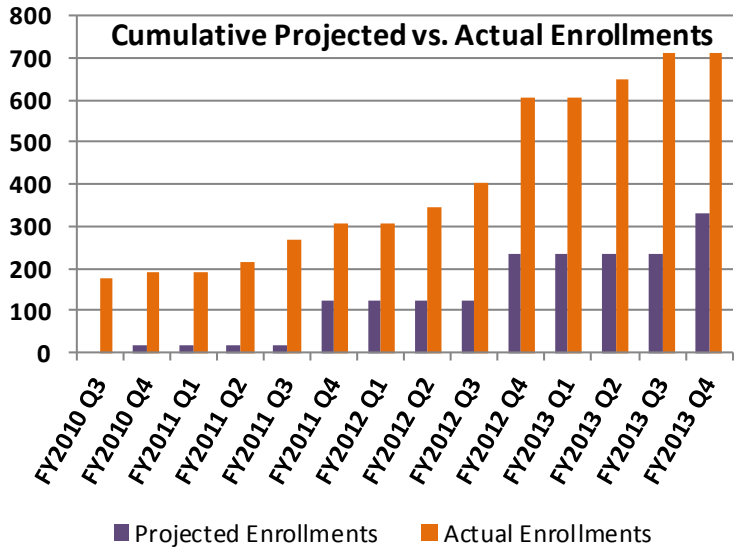
Mississippi

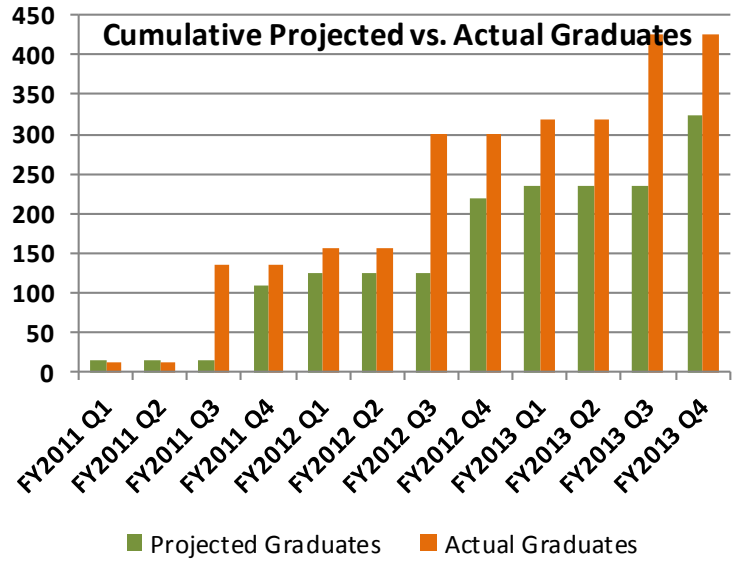
CID: OE0000484

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
Incumbent Worker		**Apprentice Lineman Training**		**Energy Grant Programs**	
Projected Number of Enrollments	90	Projected Number of Enrollments	45	Projected Number of Enrollments	195
Actual Number of Enrollments	176	Actual Number of Enrollments	54	Actual Number of Enrollments	482
Projected Number of Graduates	85	Projected Number of Graduates	45	Projected Number of Graduates	195
Actual Number of Graduates	176	Actual Number of Graduates	51	Actual Number of Graduates	198





National Electrical Manufacturers Association

Vids for Grids: New Media for the New Energy Workforce

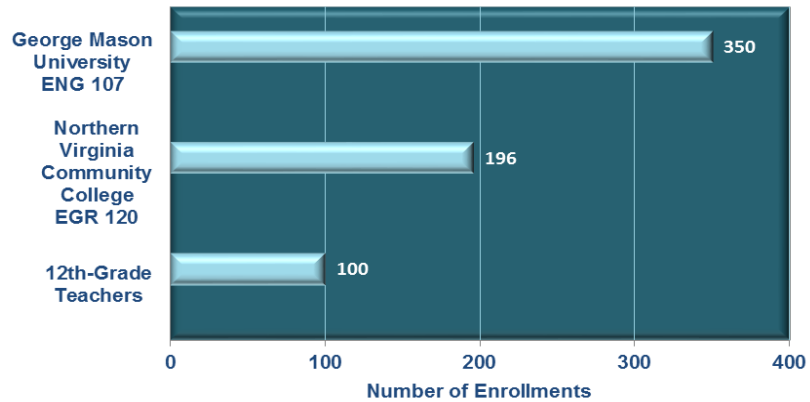
Project Description

The National Electrical Manufacturers Association (NEMA), in partnership with George Mason University and Northern Virginia Community College, produced videos that targeted senior high school or first-year college students. Each video covered concepts integral to the deployment of smart grid technologies. The videos incorporated short interviews with subject matter experts, equipment demonstrations, and (in some cases) scenes of the equipment's assembly, installation, and use. The videos were integrated into basic electrical engineering curricula and posted online for use by colleges, training centers, and the general public. Filming was done onsite at the facilities of leading power equipment manufacturers, such as A123, Beacon Power, Itron, and Thomas & Betts. NEMA also produced podcasts in which student-selected experts discussed their experiences in the power sector.

Achievements

In total, NEMA produced 12 videos and 3 podcasts. The videos were uploaded to NEMA's Vids4Grids YouTube channel, which has just over 100 subscribers. NEMA is notified of new subscribers every other week; three to five viewers become subscribers each month. When a subscriber posts a question about a video, NEMA forwards it on to the appropriate company or subject matter expert.

At the onset of the project, NEMA surveyed students to gauge their familiarity with the smart grid. The survey results indicated that only 10 percent of students were aware that the smart grid existed. Surveys administered before students watched any of NEMA's videos generated similar results. After watching one video, however, about 25 percent of students rated themselves "familiar with" the smart grid, and after two videos, that percentage increased to 35. In addition, all companies involved with the project continue to report that they are pleased with the project's results and have used NEMA's videos in their own newsletters, trainings, and promotional materials.



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PARTNERS

George Mason University
Northern Virginia Community College

PROJECT DURATION

7/16/2010–12/15/2011

COST

Total Project Value
$319,243

DOE/Non-DOE Share
$165,876/$153,367

PROJECT LOCATION

Virginia

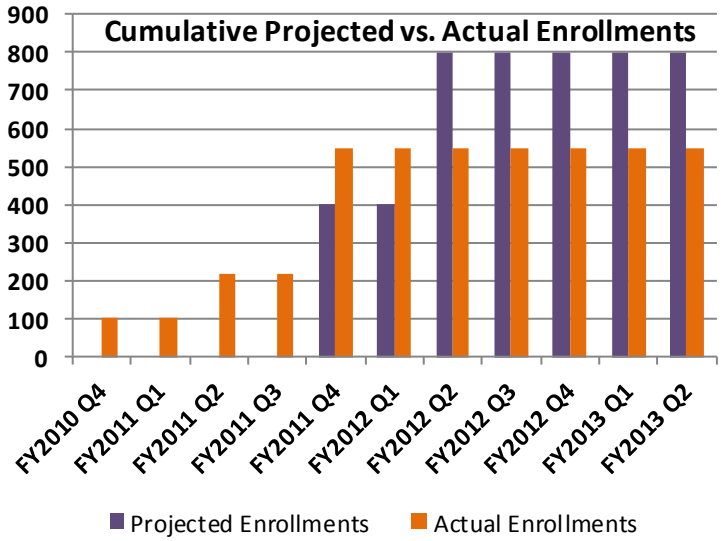
CID: OE0000463

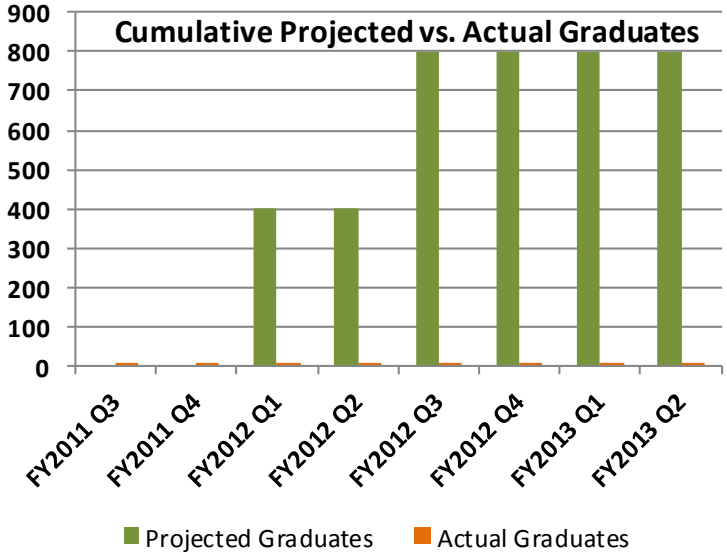
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
George Mason University		**Northern Virginia Community College**	
Projected Number of Enrollments	400	Projected Number of Enrollments	400
Actual Number of Enrollments	350	Actual Number of Enrollments	196
Projected Number of Graduates	400	Projected Number of Graduates	400
Actual Number of Graduates	10	Actual Number of Graduates	0*

*Recipients were required to report projected enrollments and graduates that occurred only during the project performance period of the grant.





Navajo Tribal Utility Authority
Smart Grid Workforce Training

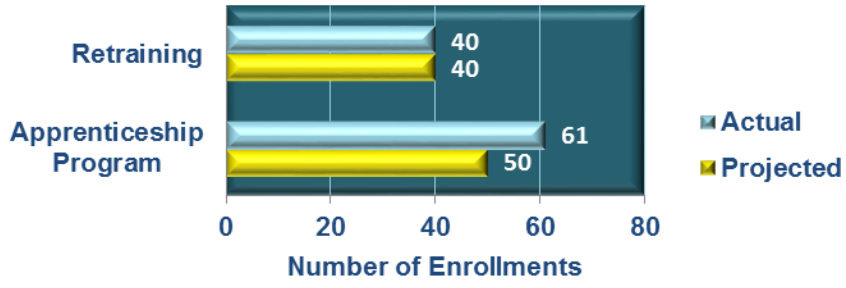
Project Description

The Navajo Tribal Utility Authority (NTUA) has been diversifying its power generation sources and modernizing its distribution services through the upgrade of remote switching and monitoring operations, feeder and substation automation for online monitoring and equipment interoperability, and the deployment of information technology solutions. In support of these improvements, NTUA developed a program to provide trainees with the skills to continue these upgrades and contribute to rolling out a nationwide smart grid. NTUA's training program maximized employment opportunities for citizens of the Navajo Nation, helped reduce unemployment, and aided in smart grid implementation.

Achievements

NTUA's training encompassed an apprenticeship program that covered such topics as the design of advanced metering infrastructure (AMI) meters, the operation of AMI meters, and the integration of AMI meters with legacy equipment. By completing the 4-year program, trainees attained journeyman status as electricians, line repairers, and meter repairers. The Department of Labor has certified the apprenticeship program, and the credentials trainees earn by completing it are recognized throughout the industry. NTUA also launched a meter-reader retraining initiative to make it easier for employees to take on different responsibilities after the implementation of AMI eliminated their positions. The employees who completed the retraining became electrician helpers, electric substation helpers, and communication technicians. In doing so, they adapted their skillsets to the changing electric industry and increased their earning potential.

Through NTUA's partnership with Navajo Technical College, the project included a 30-hour course on how Occupational Safety and Health Administration regulations apply to the construction industry. By working with the University of Wisconsin, NTUA also offered three electrical-engineering courses at NTUA facilities: Electrical Distribution Principles and Applications, Designing Electrical Overhead Distribution Lines, and Designing Electrical Underground Distribution Lines. Offering these courses onsite made it possible for more utility employees to take them. Increasing access to the courses in this way was especially important to NTUA, given the relatively remote location of its facilities.



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PARTNERS

Navajo Technical College
University of Wisconsin

PROJECT DURATION

7/1/2010–6/30/2013

COST

Total Project Value
$1,408,972

DOE/Non-DOE Share
$704,486/$704,486

PROJECT LOCATION

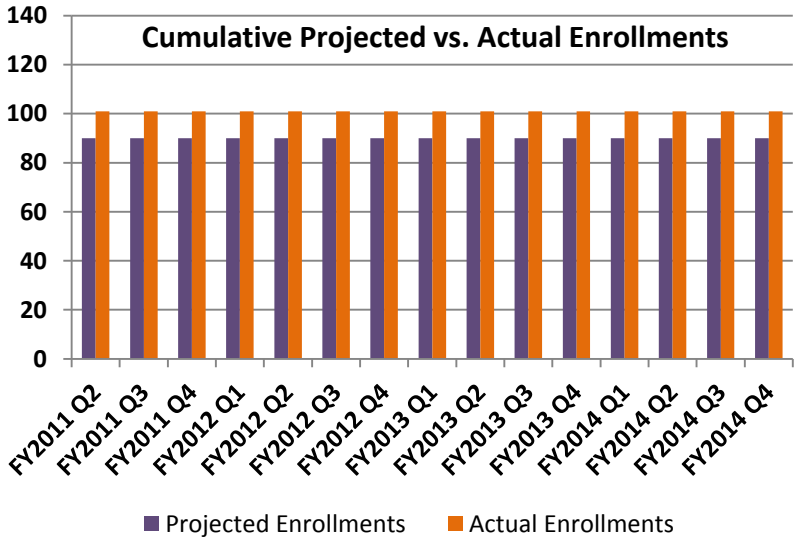
Arizona
New Mexico
Utah

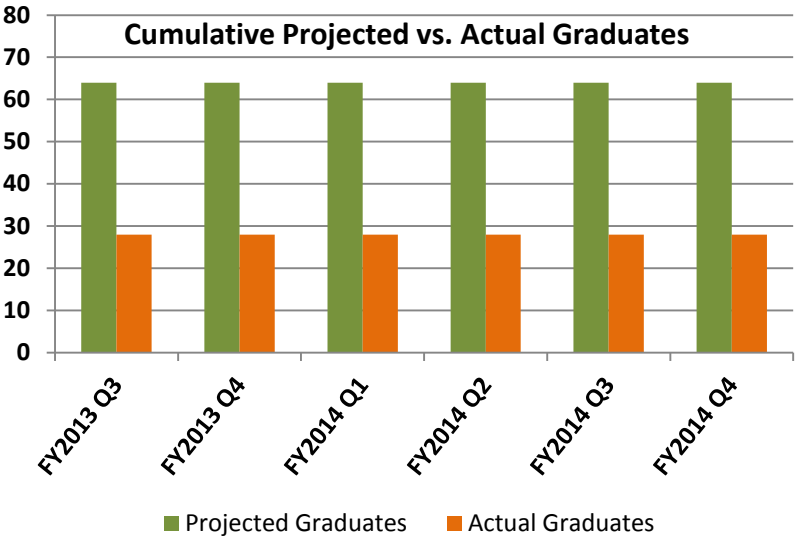
CID: OE0000442

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Apprenticeship Program		**Retraining**	
Projected Number of Enrollments	50	Projected Number of Enrollments	40
Actual Number of Enrollments	61	Actual Number of Enrollments	40
Projected Number of Graduates	24	Projected Number of Graduates	40
Actual Number of Graduates	22	Actual Number of Graduates	6





The Apprenticeship Program could take up to four years to complete; therefore, the number of graduates is significantly less than the number of enrollees because many that enrolled were not expected to complete the training by the end of the period of performance.

The meter reader retraining initiative was introduced to assist employees with career planning for those employees whose positions were being eliminated by the AMI project implementation. However, NTUA decided to defer deployment of water and natural gas metering; thus, meter reader positions continue to be needed at NTUA and in the near future. Only six of the forty meter readers moved into new positions and were retrained under the Retraining Program. The employees accepted positions as electrician helpers, electric substation helpers, and communication technicians.

North Carolina State University

Master of Electric Power Systems Engineering

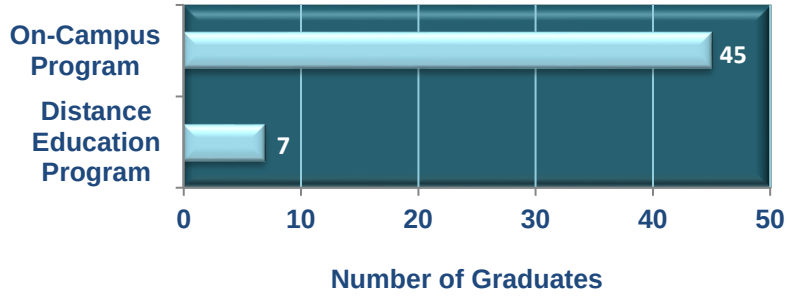
Project Description

North Carolina State University (NC State) is developing an intensive professional Master's degree program for power system engineers and managers to develop and deploy next generation Smart Grid systems. The Master of Electric Power Systems Engineering (MEPSE) covers both core power engineering topics, Smart Grid applications, and cross-disciplinary courses, including risk management, communication skills, project management, engineering economics, and technical writing. MEPSE targets new graduates in the utility industry, displaced workers seeking a new career, and current utility industry employees seeking to enhance their skills. It is an intensive systems-focused, hands-on program designed for training a population with diverse backgrounds in approximately 10 months. NC State plans to grow the program through an innovative, real-time distance learning component to accommodate a broader audience.

Achievements

MEPSE is now a flagship power-engineering program at NC State. Accredited as a professional science master program, MEPSE encompasses three main components. The first is a set of core power systems engineering courses. The second consists of two courses introducing technical topics in power systems engineering: Power Engineering Practicum I and II. Finally, the third component consists of electives that allow students to specialize in their area of interest. Electives range from Electric Motor Drives, through the Business of the Electric Utility, to Power System Stability.

A survey of graduates indicates that MEPSE increased their employment opportunities and was more advantageous than other master's-level programs that focused on power. The survey also indicated that graduates felt adequately trained as a result of MEPSE. The program's capstone project and professional skills classes were particularly useful in this regard. Most survey respondents stated, further, that MEPSE made them more credible job candidates, increased their industry recognition, and caused their on-the-job responsibilities to rise. Almost all respondents (92 percent) would recommend the course to undergraduates. These survey results bear out the program's success.



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PARTNERS

Alstrom Grid
Quanta
Progress Energy
ABB
KEMA

PROJECT DURATION

6/30/2010–6/30/2015

COST

Total Project Value
$3,445,424

DOE/Non-DOE Share
$2,492,266/$953,158

PROJECT LOCATION

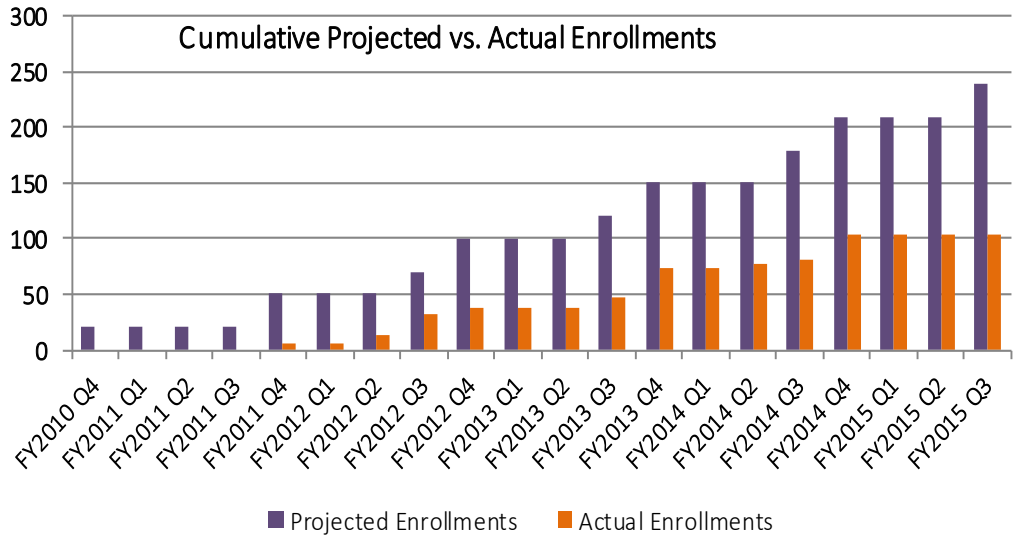
North Carolina

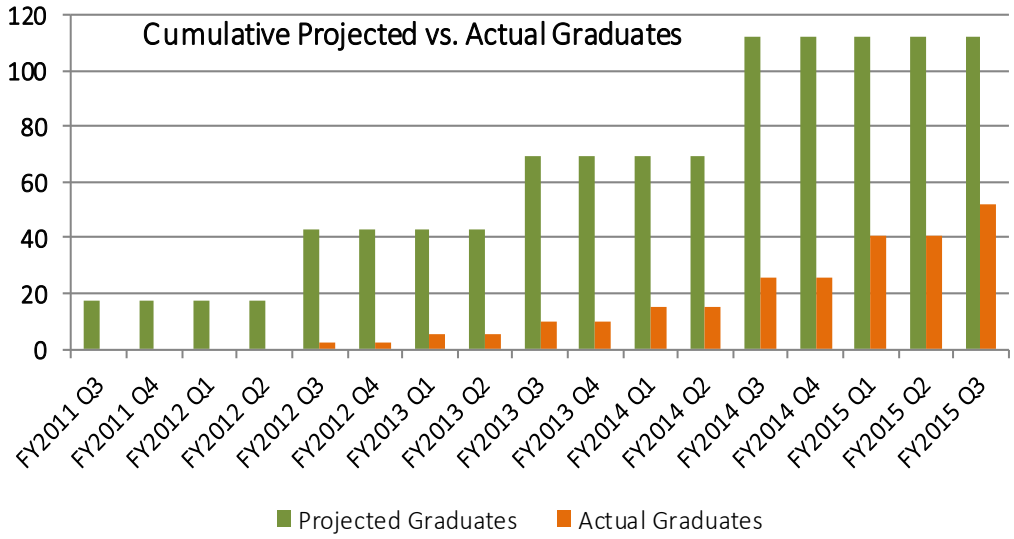
CID: OE0000437

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
MEPSE On Campus Program		MEPSE Distance Education Program	
Projected Number of Enrollments	170	Projected Number of Enrollments	70
Actual Number of Enrollments	72	Actual Number of Enrollments	31
Projected Number of Graduates	95	Projected Number of Graduates	17
Actual Number of Graduates	45	Actual Number of Graduates	7





Graduates for the Distance Education Program were first realized in FY2014 Q3.

Northeast Wisconsin Technical College

NEW Generation Power Skills Training Development Initiative

Project Description

The NEW Generation Power Skills Development Initiative developed and enhanced regional training programs for the emerging smart grid workforce by taking industry-identified skills into account and using multiple delivery methods to accommodate learners' diverse needs. The initiative maximizes the resources and expertise of Northeast Wisconsin Technical College (NWTC) and its three partner colleges to integrate a standardized set of core competencies into smart-grid-related programming, either through new courses or modifications to existing ones.

Achievements

NWTC and its project partners designed a training program with a wide range of students in mind, including traditional students, incumbent workers, and the unemployed. NWTC enhanced nine of its existing courses—covering such topics as energy investment analysis, photovoltaics, utility system maintenance, and gas utility field training—to encompass smart-grid-related topics. Two new smart grid credentials were also developed. The first (a certificate in smart grid fundamentals) included courses that gave an overview of the smart grid, discussed smart grid deployment and lessons learned, and dealt with regulatory oversight, rate regulation, and the smart grid's impact on utility rates. The second (a certificate in distribution system automation) covered distribution management systems, automation, and protection as they relate to the smart grid; microgrids; enhanced substations; and system control and data acquisition.

To give students practical experience with smart grid technologies, NWTC designed and bought a mobile smart grid training lab. Because the lab was not stationary, it could deliver smart grid training to incumbent workers and college students in various locations, increasing the training's accessibility. In particular, the mobile lab has increased access to 18 electromechanical courses, which feature both an online component and lab work. The mobile lab contains actual substation devices (for instance, fault-protection relays, smart meters, and a Global Positioning System clock to enable synchrophasor analysis). It can be used to teach students about feeder overcurrent protection, communication with intelligent electronic devices, and distribution automation systems that increase the grid's reliability.

In the future, NWTC plans to offer up to 30 more electromechanical courses that blend online and hands-on learning. NWTC also plans to offer a third certification—one that focuses on the needs of utility customers. NWTC did not launch its new and enhanced smart grid courses until the fall semester of 2013, after the grant period had ended. During the period of performance, however, NWTC did provide a train-the-trainer workshop for four faculty members who would teach the courses, and demonstrated the mobile lab to utility and energy organizations across Wisconsin.

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PARTNERS

Fox-Valley Technical College
Moraine Park Technical College
Lakeshore Technical College

PROJECT DURATION

7/1/2010–6/14/2013

COST

Total Project Value
$859, 233

DOE/Non-DOE Share
$750,000/$109,233

PROJECT LOCATION

Wisconsin

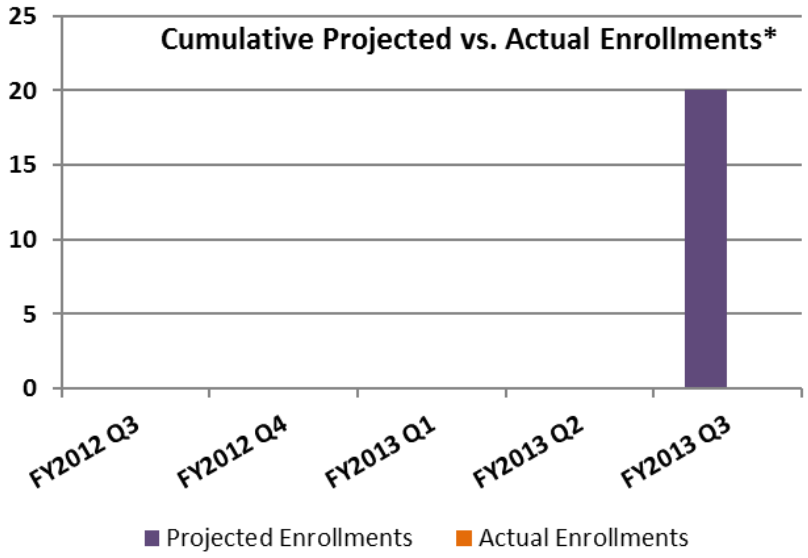
CID: OE0000445

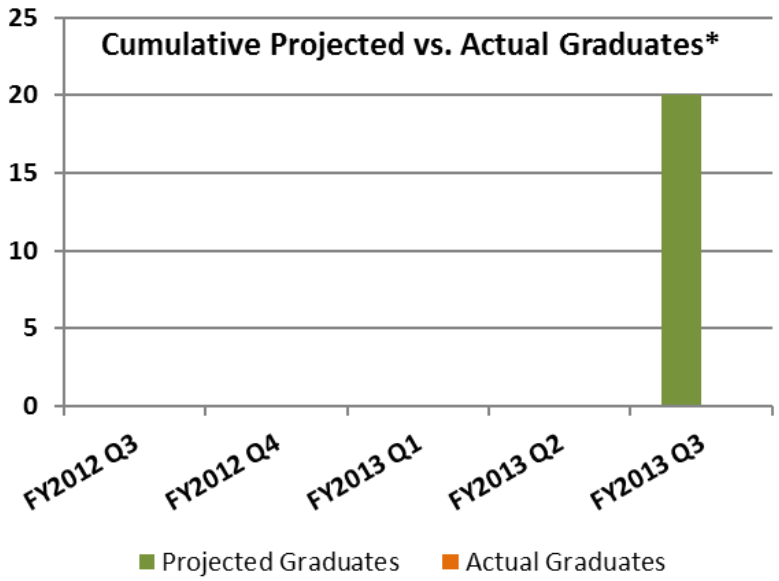
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Smart Grid Fundamentals Certificate		**Distribution System Automation Certificate**	
Projected Number of Enrollments	20	Projected Number of Enrollments	20
Actual Number of Enrollments	0*	Actual Number of Enrollments	0*
Projected Number of Graduates	0*	Projected Number of Graduates	0*
Actual Number of Graduates	0*	Actual Number of Graduates	0*

* Recipients were required to report projected enrollments and graduates that occurred only during the project performance period of the grant.





*NWTC did not enroll and/or train anyone during the grant period. The Smart Grid Certificate courses were first rolled out and offered in the Fall Semester of 2013.

Although classes were not offered, NWTC provided a Train-the -Trainer workshop for four faculty members, as well as a demonstration of the lab and coursework to utility and energy organizations throughout the state (i.e., the Municipal Electric Utilities of Wisconsin (MEUW) Conference, Wisconsin Energy Research Consortium (WERC), Georgia Pacific, and Wisconsin Public Service) .

Northern Michigan University

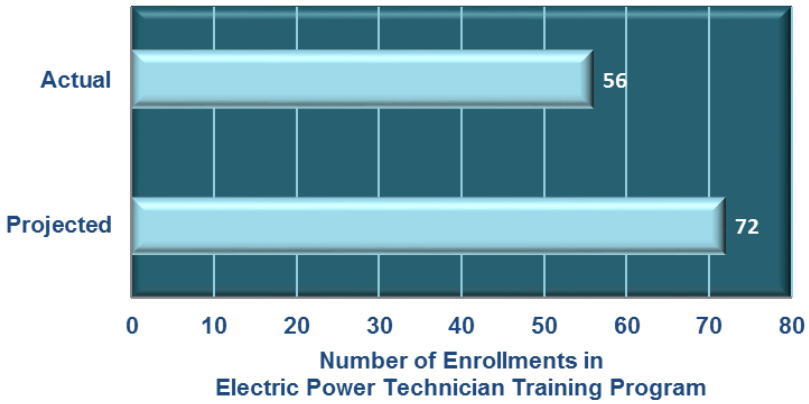
Electrical Power Technician Workforce Training Program

Project Description

Northern Michigan University (NMU) established a training center to provide training that includes both the knowledge and skills required for an entry-level technician in the electrical power industry. NMU's mock electrical substation provided students with a hands-on laboratory, including actual equipment, which enabled them to practice skills that are needed in the workplace. Lab size was limited to 12 students. A program coordinator was designated to make sure that the program included all relevant technology in use and under development. NMU developed the curriculum in consultation with industry partners.

Achievements

Although NMU could not attract as many students to the program as planned, employers who hired graduates of the program have been highly complementary of the knowledge and skills taught through the curriculum. That is due, at least in part, to the input electric utilities provided for enhancing NMU's established power technician training program. Technical courses covered such topics as DC and AC circuit theory, discrete semiconductor devices, digital integrated circuits, and Occupational Safety and Health Administration regulations. Courses dedicated to power technician training familiarized students with the operation and maintenance of distribution substations, introduced them to commonly used transformers, covered the theoretical and practical aspects of 3-phase electrical power generation and distribution, and taught them about protective relay systems. By making a mock substation available to students in the power technician training program, NMU further ensured that the training students received would be relevant in an industrial environment. Limiting the number of students who could use the mock substation during a class period also improved the education the students received, giving all of the students a chance to interact with the state-of-the-art equipment available there.



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PARTNERS

American Transmission Company
Upper Peninsula Power Company
Systems Control
Marquette Board of Light & Power
MJ Electric

PROJECT DURATION

6/9/2010-6/8/2013

COST

Total Project Value
$805,367

DOE/Non-DOE Share
$673,462/$131,905

PROJECT LOCATION

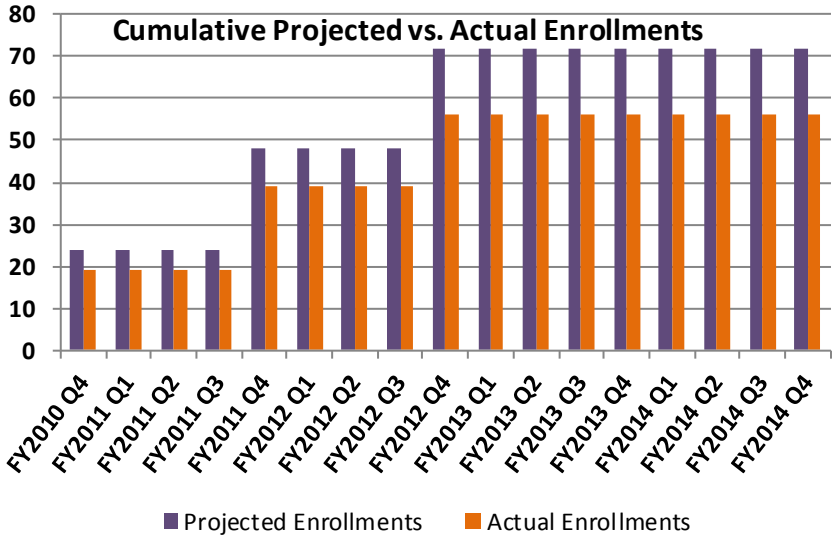
Michigan

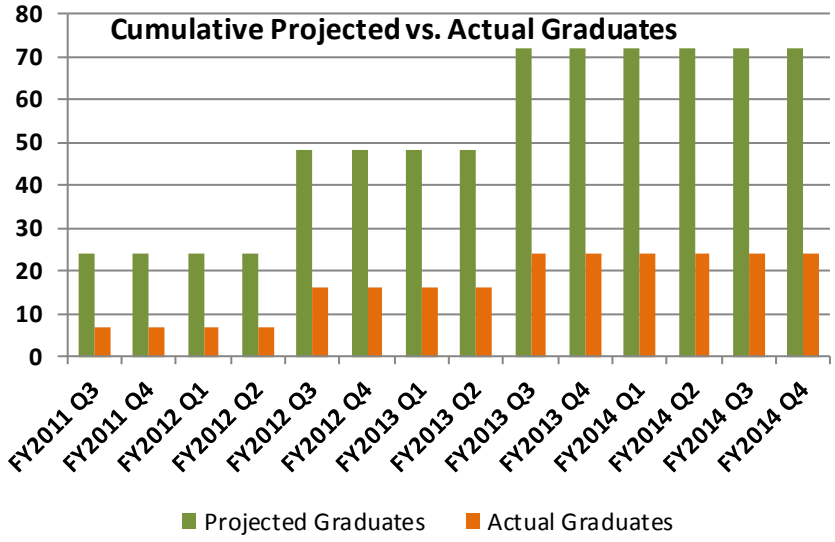
CID: OE0000444

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Electric Power Technician Training Program	
Projected Number of Enrollments	72
Actual Number of Enrollments	56
Projected Number of Graduates	72
Actual Number of Graduates	24





The Electric Power Technician Training Program is a two-year curriculum and was in place prior to the grant award. The planned number of enrollees and graduates is predicated on a class size of 24 students. However the class that was in progress at the time of the grant's initiation was only 7 students; therefore, there was actually never any way to reach the planned number of graduates. It should also be noted, due to the program actually taking two years to complete and this being a three-year grant, there were twelve students included in the enrolled numbers that graduated in the second quarter of 2014. Low enrollment was the program's largest problem, but the numbers shown are not totally indicative of the actual program productivity.

The Ohio State University

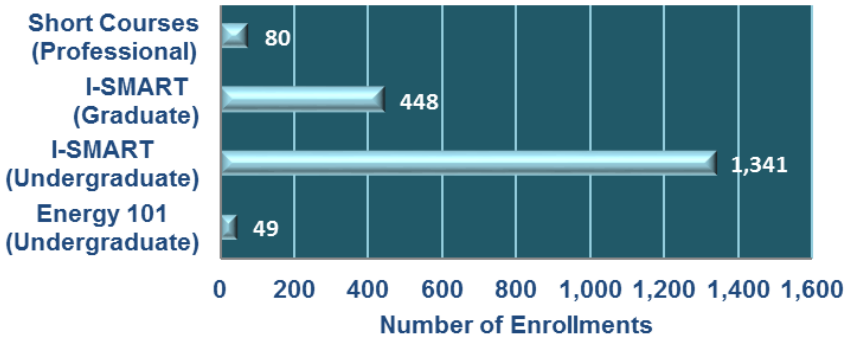
I-SMART: Integrated Curriculum for Smart Power Engineering

Project Description

The Ohio State University (OSU) developed courses and web-enabled distance learning systems to educate next-generation engineering students and electric power engineers. OSU's I-SMART curriculum helped bridge the gap between basic education for the electric power sector and the needs of the smart grid, such as power electronics, distributed control, networks and communications, sustainable energy, clean coal technology, high-voltage engineering, and game-theory-based policy and pricing. OSU used its virtual, hardware-in-the-loop smart grid test platform as a training tool to simulate smart grid subsystems. American Electric Power provided expertise in course development.

Achievements

During the project, OSU developed or updated 11 courses that made up the I-SMART curriculum. Some of the I-SMART courses were interdisciplinary (such as those that covered clean coal and electricity markets), and others were engineering-specific (including courses on power electronics circuits and on sustainable energy and power systems). By offering all I-SMART courses online as well as in person, OSU broadened the courses' reach. The courses also proved inherently popular. When courses such as Electric Machines and High-Voltage Engineering and Laboratory were offered, for example, waitlists became necessary. OSU's novel smart grid test platform was adept at providing real-time subsystem simulations, and OSU now uses it for both undergraduate and graduate-level education. In addition, an entry-level course titled Energy 101 was offered both in class and via distance learning. Because Energy 101 did not become a required course for all freshmen, as initially planned, enrollment was lower than expected. Still, the course met the project's goal of promoting environmental consciousness at the university level.



Success Story

The online version of Power Electronics, a course in the I-SMART curriculum, was offered to engineers from General Motors. More than 80 of the engineers completed the class via distance learning.

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PARTNERS

American Electric Power
Opal RT

PROJECT DURATION

5/13/2010– 9/30/2013

COST

Total Project Value
$3,796,484

DOE/Non-DOE Share
$2,499,939/$1,296,545

PROJECT LOCATION

Ohio

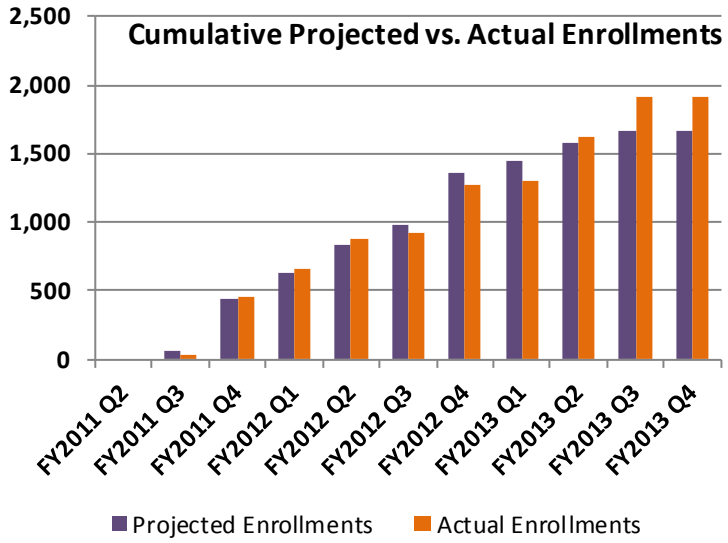
CID: OE0000402

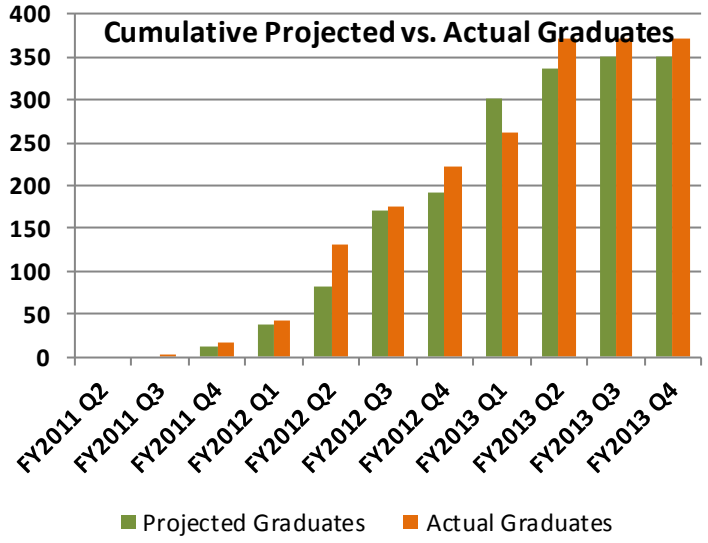
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
Energy 101 (Undergraduate Program)		**I-SMART (Undergraduate Program)**		**Short Courses (Professionals)**	
Projected Number of Enrollments	180	Projected Number of Enrollments	870	Projected Number of Enrollments	150
Actual Number of Enrollments	49	Actual Number of Enrollments	1,341	Actual Number of Enrollments	80
Projected Number of Graduates	70	Projected Number of Graduates	92	Projected Number of Graduates	150
Actual Number of Graduates	2	Actual Number of Graduates	235	Actual Number of Graduates	80

I-SMART (Graduate Program)	
Projected Number of Enrollments	460
Actual Number of Enrollments	448
Projected Number of Graduates	38
Actual Number of Graduates	54





Oncor Electric Delivery Company

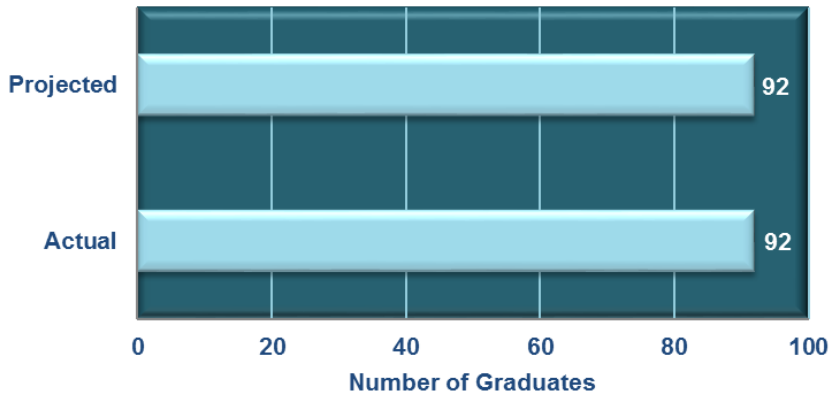
Grid Reliability through Engineering Advancement and Training

Project Description

Oncor Electric Delivery Company partnered with Siemens Power Technologies International to provide training in transmission planning and system protection due to increased urban energy loads and to meet the need for specialized wind power studies. Students focused on developing practical problem-solving abilities and building a greater working knowledge of transmission power systems. The training enabled engineers to plan, design, and protect a smart grid.

Achievements

Oncor engineers could choose from among several training courses offered by Siemens. These included courses on protective relaying, power flow, dynamic simulation, the reliability of power systems and how they relate to wind integration, and power electronics in transmission systems and wind power. The training better equipped engineers to meet the challenges associated with Oncor's Competitive Renewable Energy Zones project, which connected planned wind generators in West Texas to markets in north-central and central Texas. The project taught students about implementing series compensation, static var compensation, and other technologies new to the company. Without the training, implementing the new technologies would have been difficult, if not impossible, to accomplish. More broadly, the training improved how well engineers could keep the grid secure, reliable, and efficient and deliver greater amounts of variable wind energy to load centers and, ultimately, to customers.



Success Story

As an added benefit, the training helped engineers accelerate their careers. During the project period, 17 engineers received promotions due, at least in part, to the knowledge they gained from the training. Two of those promotions were so dramatic that the employees were lifted out of the cohort entirely.

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PARTNERS

Siemens Power Technologies International

PROJECT DURATION

6/10/2010–6/9/2013

COST

Total Project Value
$331,450

DOE/Non-DOE Share
$150,969/$180,481

PROJECT LOCATION

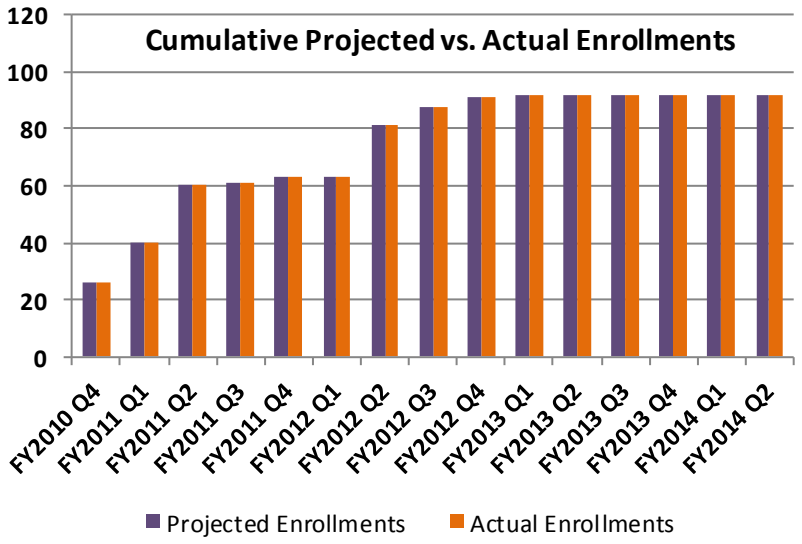
Texas

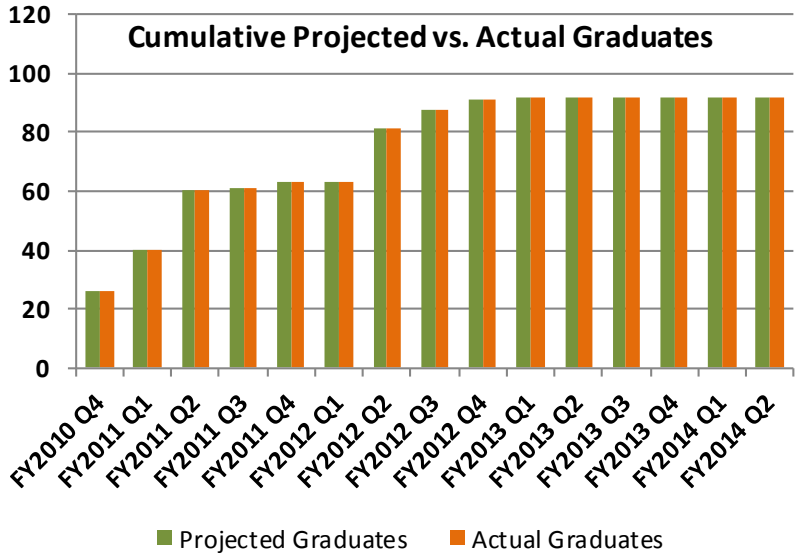
CID: OE0000456

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Utility Training Programs	
Projected Number of Enrollments	92
Actual Number of Enrollments	92
Projected Number of Graduates	92
Actual Number of Graduates	92





Oregon Institute of Technology

Strategic Training and Education in Power Systems

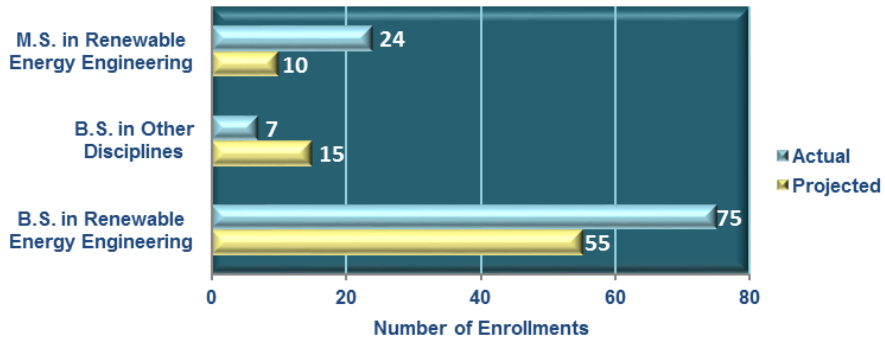
Project Description

The Oregon Institute of Technology's (OIT) project cross-trained power engineering graduates in electrical, mechanical, and energy engineering, building on a strong foundation in mathematics and science. OIT graduates were given a firm understanding of renewable energy source integration, energy policy, and economics. OIT augmented its curriculum and faculty resources, expanded its laboratory capabilities, and increased its industry collaboration to raise the number of energy and systems engineers in the electric power industry.

Achievements

OIT added coursework to its bachelor's degree in renewable energy engineering and launched a master's degree in the subject. Both curricula focused on the generation, transmission, and distribution of electricity; energy storage; and the design of related power electronic devices. Even students in other undergraduate programs completed coursework that covered power, electric machines, and power electronics. To ensure that students were prepared to face the challenges presented by modernizing the grid, OIT included in its new coursework a look at the power industry's history, its economics, and the policies that influence it. Students were also given the chance to design power generation and transmission equipment, components of energy storage systems, and power electronics. Evening classes and distance education made these educational offerings more accessible to nontraditional students.

Five power-related laboratories now support education in the areas of embedded systems, digital signal processing, and communications systems. For example, students can use the enhanced Utility-Appropriate Energy Storage Lab to fabricate and test polymer-electrolyte-membrane fuel cells, and they can use the Distributed Power Systems Testing Lab to investigate microgrids. Some students gained experience, not just in the lab, but also in the energy sector. Twenty-nine students completed internships with such companies as Clear Edge Power (a fuel-cell manufacturer) and SolarCity (an installer of solar systems), as well as with Bonneville Power Administration (a federal nonprofit that markets wholesale electrical power and operates high-voltage transmission lines).



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PARTNERS

None Listed

PROJECT DURATION

7/7/2010–7/6/2013

COST

Total Project Value
$2,869,065

DOE/Non-DOE Share
$2,491,100/$377,965

PROJECT LOCATION

Oregon

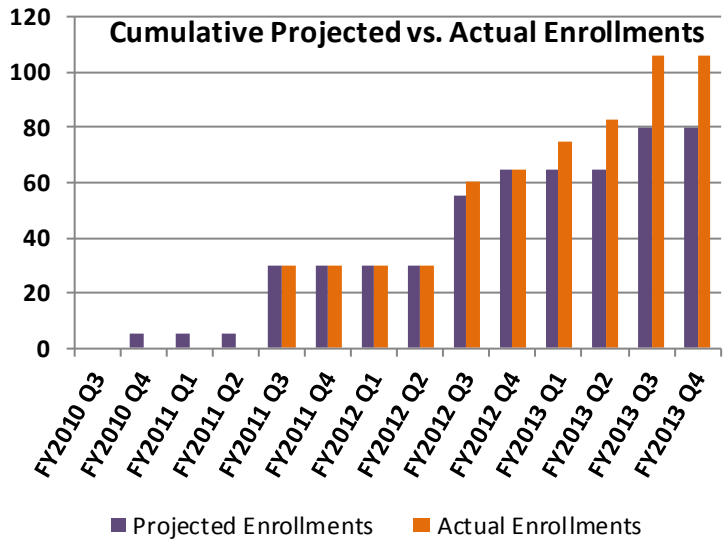
CID: OE0000404

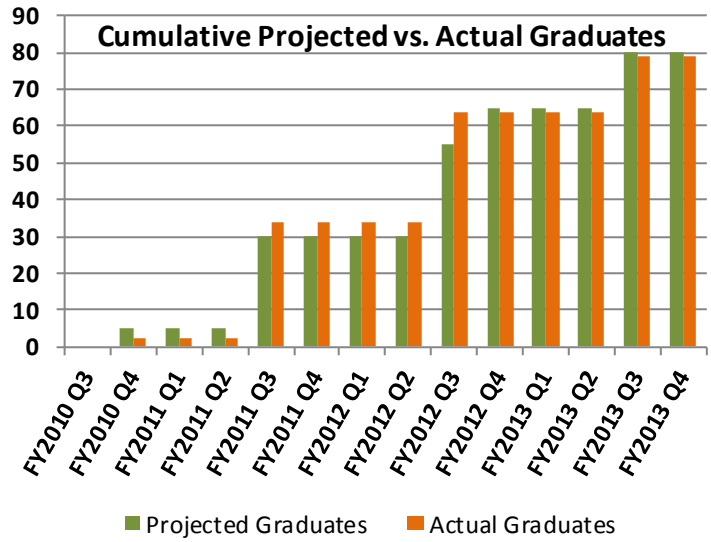
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
BS Renewable Energy Engineering		**BS Undergraduate Program (Other)**		**MS Renewable Energy Engineering**	
Projected Number of Enrollments	55	Projected Number of Enrollments	15	Projected Number of Enrollments	10
Actual Number of Enrollments	75	Actual Number of Enrollments	7	Actual Number of Enrollments	24
Projected Number of Graduates	55	Projected Number of Graduates	15	Projected Number of Graduates	10
Actual Number of Graduates	75	Actual Number of Graduates	4	Actual Number of Graduates	0*

*Recipients were required to report graduates that occurred only during the project performance period of the grant. No students completed the MS in Renewable Energy Engineering during the period of performance.





Pepco

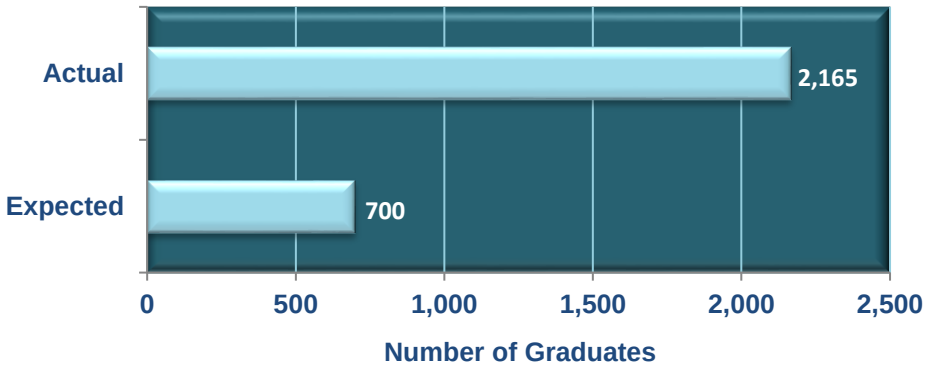
Smart Grid Workforce Training Project

Project Description

This project trained the next generation of electric utility technicians in four primary areas: customer engagement with adoption of energy efficiency, dynamic pricing, direct load control, and distributed generation programs; deployment and operation of smart metering, load control, distribution automation, and grid optimization infrastructure; the implementation, operation, and control of a two-way communications infrastructure; and compliance with standards to ensure interoperability and cyber security.

Achievements

Over 2,000 Pepco employees have been trained in smart-grid-related technology so that Pepco can exploit its newly installed smart devices and provide sound energy advice to its customers. The training included coursework on automated metering infrastructure, cable splicing, remote connects and disconnects, field collection payments, customer service, energy advisement, and energy conservation, among numerous other topics. The number of employees who completed the training programs represent a greater than threefold increase over Pepco's original plan to train just 700 employees. The increase was due to Pepco's growing need to train its employees to meet the utility's smart grid objectives. As a consequence of the project, more than 35 positions have been created to operate, maintain, and sustain the smart grid technologies that Pepco invested in. Pepco intends to continue its workforce training efforts as new employees are hired and as smart grid technologies evolve.



Success Story

Forty-nine Pepco employees—temporary and permanent—faced the possibility of displacement as a result of smart grid technologies' implementation. Because of this project, these employees were retrained for new positions and could remain with Pepco.

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PARTNERS

None Listed

PROJECT DURATION

4/30/2010–9/30/2013

COST

Total Project Value
$7,871,928

DOE/Non-DOE Share
$3,978,348/$3,893,580

PROJECT LOCATION

Maryland

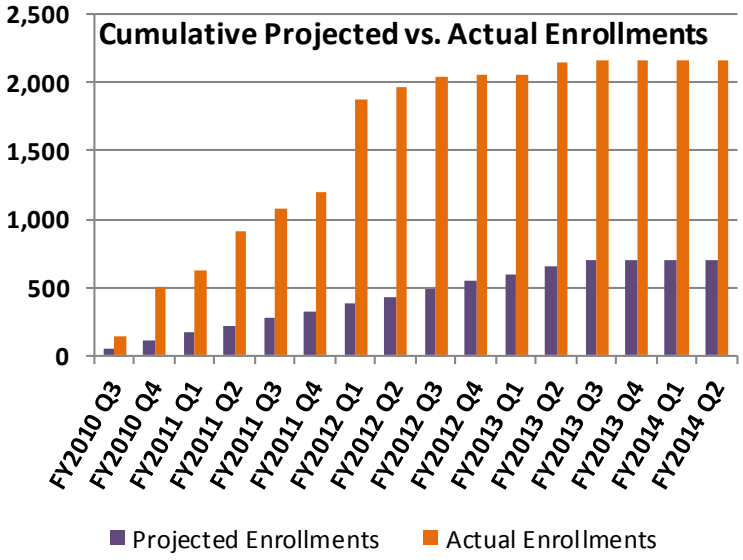
CID: OE0000393

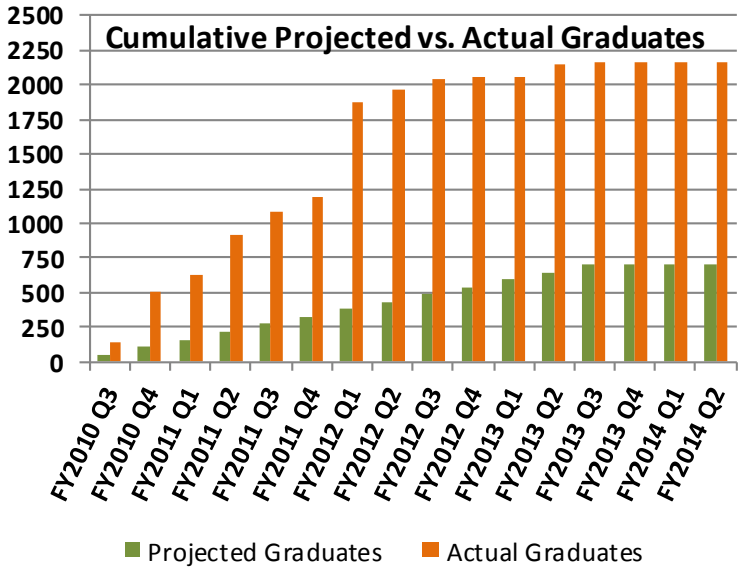
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

PEPCO HOLDINGS, INC.

Metrics

Total Course Data	
Utility Training Programs	
Projected Number of Enrollments	700
Actual Number of Enrollments	2,165
Projected Number of Graduates	700
Actual Number of Graduates	2,165





Over 2,000 employees have been trained in Smart Grid-related technology, which reflects a significant increase over the projected estimate of 700 employees. The increase was a necessity to meet Smart Grid objectives.

Pratt Community College

Smart Grid Curriculum Development

Project Description

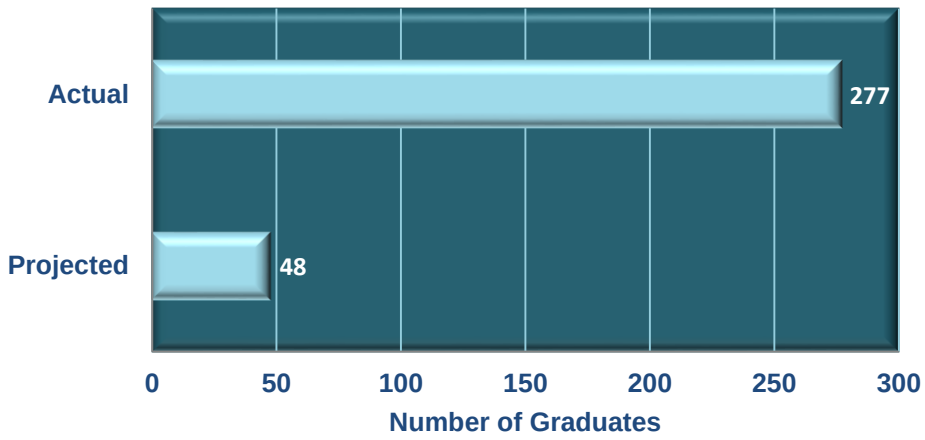
Pratt Community College (Pratt) formed the Kansas Community College Energy Consortium to develop training that meets the needs of the electric power industry. This project developed online courseware that included smart grid enhancements, which could be used in conjunction with multiple courses offered by project partners. Online/hybrid smart grid training modules were also developed. Completed smart grid training materials provided for career exploration as well as training for new and incumbent workers.

Achievements

Pratt and its project partners delivered a portfolio of learning materials that gave students both a theoretical and practical education in smart grid concepts. Some materials trained students to use an oscilloscope, familiarized them with phasor and harmonic analyzers, and demonstrated how to measure three-phase power. Others consisted of laboratory units that focused on the fundamentals of electrical power technology; power, phasors, and impedance in AC circuits; special transformer connections; the fundamentals of rotating machines; DC motors and generators; and many other subjects. Lab units could be performed with either an actual or virtual electromechanical system.

In addition, Pratt and its project partners developed modules on electric power generation and transmission, electric power and natural gas distribution, safety, and the history and organization of the energy industry.

Not only are the unexpectedly high enrollment and graduation numbers a testament to the project's success, but so too is the positive feedback students provided on evaluation surveys. Ninety-seven percent of students rated the learning materials and simulation exercises either somewhat or very beneficial.



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PARTNERS

Coffeyville Community College
Dodge City Community College
Flint Hills Technical College
Manhattan Area Technical College

PROJECT DURATION

8/1/2010–7/31/2013

COST

Total Project Value
$867,206

DOE/Non-DOE Share
$749,375/$117,831

PROJECT LOCATION

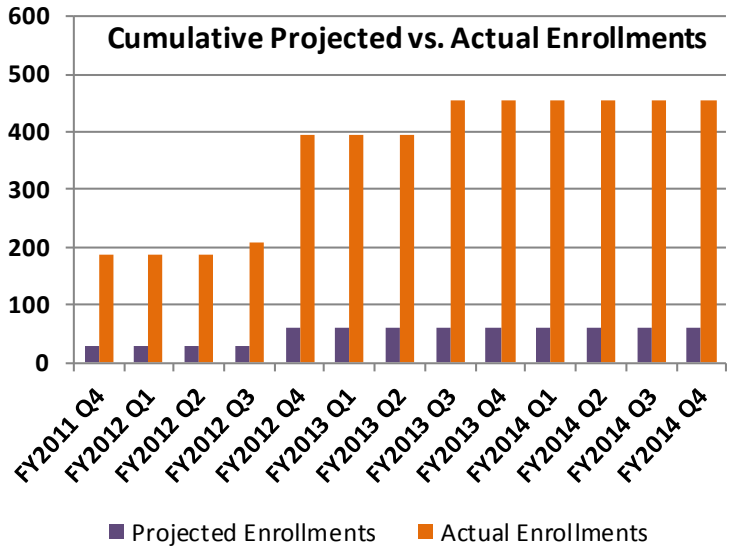
Kansas

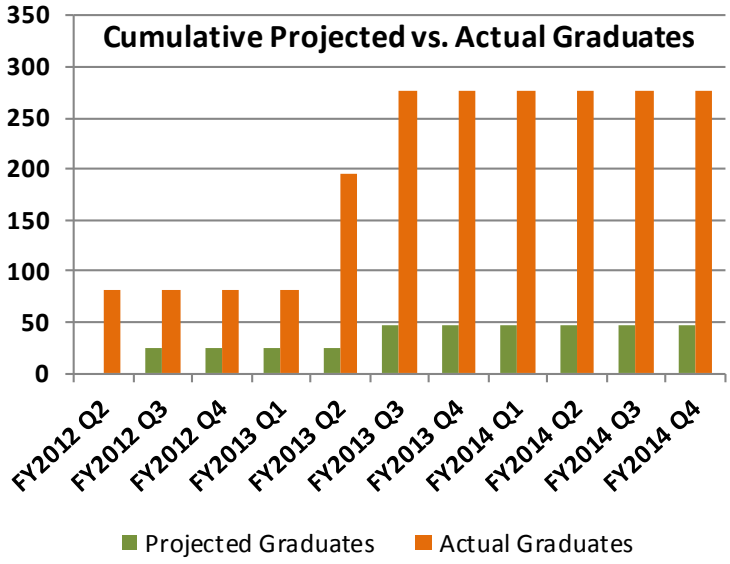
CID: OE0000464

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Technician Training Programs	
Projected Number of Enrollments	60
Actual Number of Enrollments	455
Projected Number of Graduates	48
Actual Number of Graduates	277





Princeton Energy Resources International

Mid-Atlantic Renewable Energy Education Program for Rural Electric Power Sector

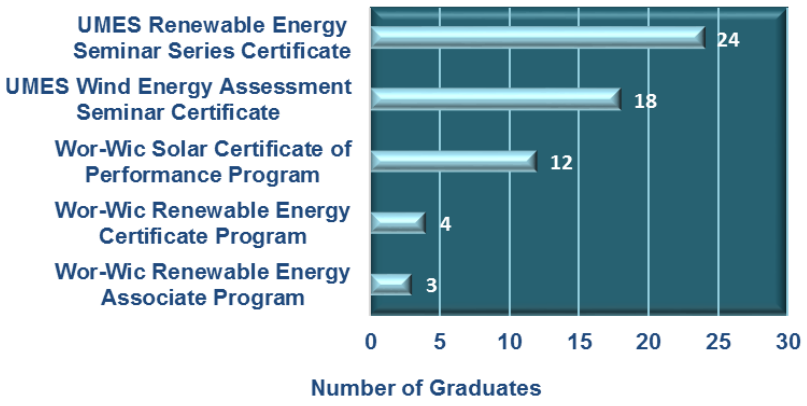
Project Description

Princeton Energy Resources International provided training and workforce development to accelerate the use of sustainable energy resources in the Mid-Atlantic. The research team implemented an associate of applied sciences (AAS) degree in environmental engineering technology, a certificate program in renewable energy, and a certificate program for installers of solar equipment—all of which were offered at Worcester and Wicomico Community College (Wor-Wic). Seminar series certificates in renewable energy concepts were also offered through the University of Maryland Eastern Shore (UMES). To further enrich the learning experience, Choptank Electric Cooperative implemented hands-on training, and the Maryland Energy Administration and Old Dominion Electric Cooperative supported mentorships and scholarships.

Achievements

Wor-Wic's new AAS in environmental energy technology equips students to enter the workforce in the electrical and energy fields, giving them a strong knowledge of alternative energy supply, transmission, and maintenance. Wind, solar, and renewable energy concepts are introduced, as are turbine technologies. Students explore green career pathways and study geographic information. Wor-Wic's certificate programs are subsets of the AAS; they cater to students who want to update their skills or enter the workforce quickly. In particular, Wor-Wic's certificate program for solar system installers proved popular as solar equipment was deployed in response to state incentives. At UMES, seminars covered multiple aspects of wind and solar energy, the integration of renewables into the grid, the economics of renewable energy, and wind energy measurement and assessment.

The Delmarva Wind Energy Research Facility at UMES, which resulted from this project, includes a 100-foot meteorological tower that provides hub height wind measurements. The facility is used to teach students about wind assessments and to provide wind measurement data for project developers.



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PARTNERS

Worchester and Wicomico Community College
Salisbury University
Choptank Electric Cooperative
Old Dominion Electric Cooperative
Maryland Energy Administration

PROJECT DURATION

7/30/2010–7/31/2015

COST

Total Project Value
$865,249

DOE/Non-DOE Share
$615,345/$249,904

PROJECT LOCATION

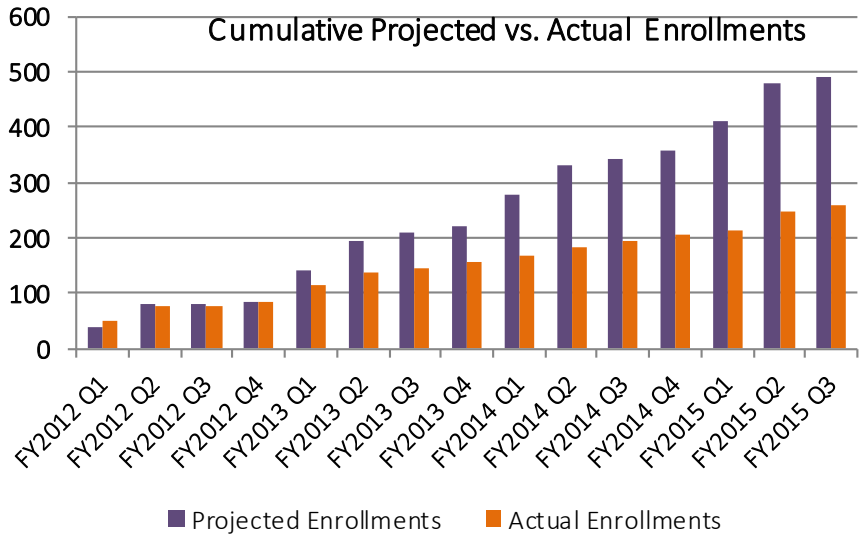
Maryland

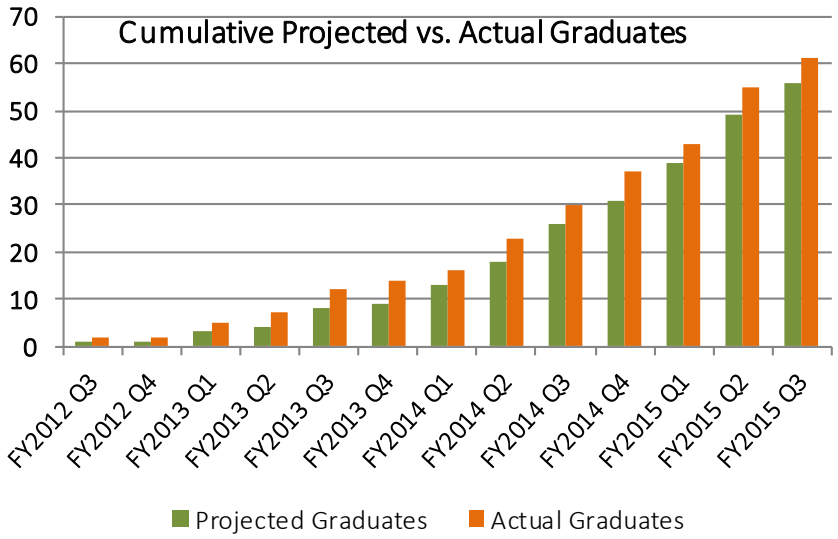
CID: OE0000440

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
Wor-Wic RE Associate Program		**Wor-Wic RE Certificate Program**		**UMES Wind Energy Assessment Cert.**	
Projected Number of Enrollments	153	Projected Number of Enrollments	167	Projected Number of Enrollments	30
Actual Number of Enrollments	76	Actual Number of Enrollments	53	Actual Number of Enrollments	18
Projected Number of Graduates	8	Projected Number of Graduates	8	Projected Number of Graduates	10
Actual Number of Graduates	3	Actual Number of Graduates	4	Actual Number of Graduates	18
Wor-Wic Solar Cert. Performance Program		**UMES Renewable Energy Business Cert.**		**UMES Renewable Energy Seminar Cert.**	
Projected Number of Enrollments	18	Projected Number of Enrollments	12	Projected Number of Enrollments	110
Actual Number of Enrollments	20	Actual Number of Enrollments	6	Actual Number of Enrollments	85
Projected Number of Graduates	10	Projected Number of Graduates	0	Projected Number of Graduates	20
Actual Number of Graduates	12	Actual Number of Graduates	0	Actual Number of Graduates	24





University of Colorado, Boulder

Strategic Networking Training for Power Systems

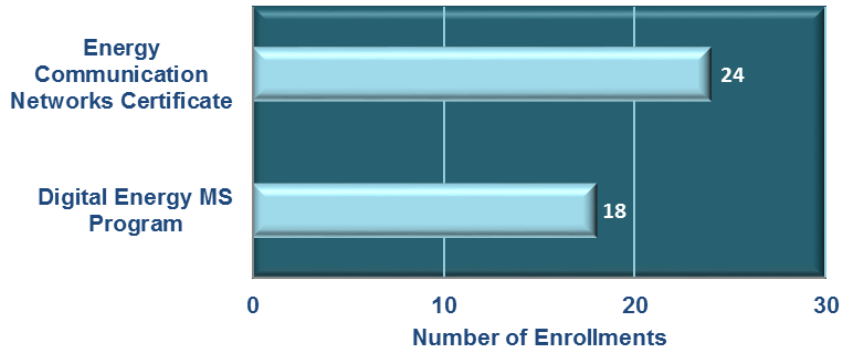
Project Description

The University of Colorado built a graduate engineering program with the capacity to train a large number of students from diverse backgrounds with the skills needed to be leaders in the smart grid workforce. The Digital Energy Program focused on networking, wireless communication, and cyber security within energy systems. Instruction was provided on campus and through long-distance learning. Students could earn a master's degree, a 5-year joint electrical engineering bachelor's degree and telecommunications master's degree, or an Energy Communication Networks certificate. Working with a large network of industry partners ensured that the curriculum was relevant, provided access to additional training opportunities and internships, and assisted in job placement. Students also worked with industry and professional associations to increase employment networking.

Achievements

To earn an Energy Communication Networks certificate or a master's degree with an energy specialization, students had to complete the following four courses: Telecommunications Systems, Data Communications I, Electric Power Grid, and Energy Communication Networks. These four courses ensured that students obtained a basic understanding of telecommunications and networking principles, and learned about the challenges associated with the electric power grid. Moreover, the project team established a telecommunications and energy lab, where students explored home area networks and the role of telecommunications in substation protective relaying. Students working toward their Digital Energy Program master's degree also used the lab to complete their capstone research projects.

An additional course, Telecom Systems, required that master's-level students attend seminars, critique speakers' presentations, and write a paper on a related topic. Annually, this course was offered with a Digital Energy Program focus; speakers who specialized in the smart grid, demand response, and other topics relevant to the electric industry were featured. Even students from outside the Digital Energy Program attended the Electric Power Grid, Energy Communication Networks, and Telecom Systems courses—evidence of the courses' broad attractiveness.



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Navigant
Schweitzer Engineering Lab
Northrup Grumman
OpenADR
Tendril
Tri-State Generation and Transmission Association
Black and Veatch

PROJECT DURATION

7/1/2010–5/31/2014

COST

Total Project Value
$1,906,165

DOE/Non-DOE Share
$1,629,429/$276,736

PROJECT LOCATION

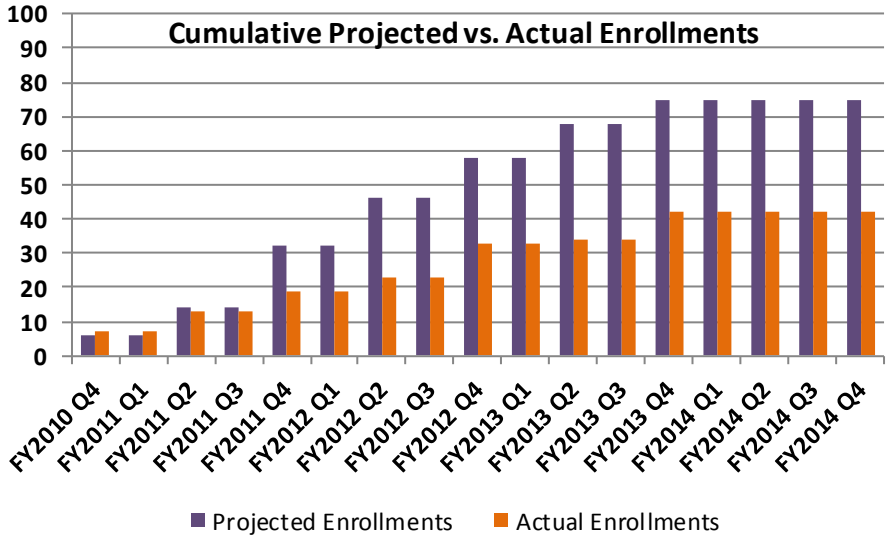
Colorado

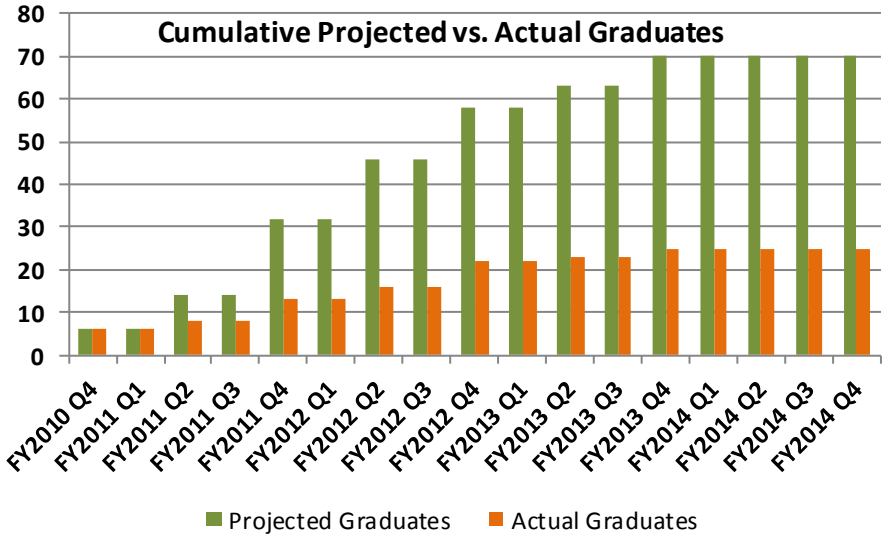
CID: OE0000436

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Energy Comm. Networks Certificate		**Digital Energy MS Program**	
Projected Number of Enrollments	34	Projected Number of Enrollments	41
Actual Number of Enrollments	24	Actual Number of Enrollments	18
Projected Number of Graduates	29	Projected Number of Graduates	41
Actual Number of Graduates	9	Actual Number of Graduates	16





University of Minnesota

Revitalization of Electric Power Engineering Education

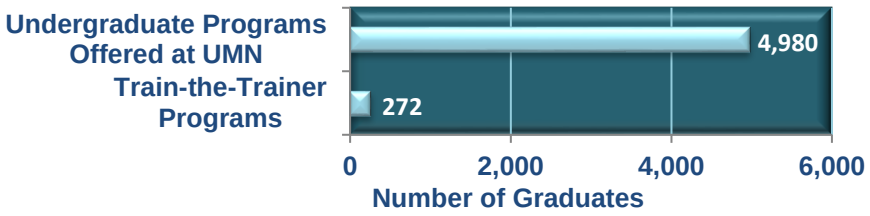
Project Description

The University of Minnesota (UMN) created a consortium of universities that shared state-of-the-art laboratories in power engineering. Programs were collectively designed and shared with consortium universities, which disseminated laboratories and curricula to non-member regional universities and to technical and community colleges. This method of dissemination enabled flexibility in filling each university's needs. Furthermore, the consortium supported faculty development and provided new classroom materials. Establishing a foundation for graduate education and research in renewable energy was also a part of the project.

Achievements

The project resulted in a 78-member consortium of universities where state-of-the-art instructional laboratories in electric power engineering were implemented. UMN helped consortium members solve the problems they encountered as they established their laboratories. In addition, a new website made a wide variety of laboratory-related information available, and curricular workshops for consortium members provided a space to share ideas, methods, and results. UMN developed three new undergraduate courses as a result of this project. Building on that success, new graduate-level labs were developed, in part, with support from this project. These graduate-level labs focused on power electronics, protection and relaying, and advanced drives.

Faculty members and teaching assistants found the project advantageous as well. This was especially the case with individuals who hadn't specialized in the power area before. The train-the-trainer programs that UMN developed prepared these individuals to develop and teach power and energy courses at their respective institutions. In the future, the institutions that make up the consortium will continue to use the UMN-developed laboratories and experiments. For its part, UMN will continue to answer lab users' questions, offer workshops, and maintain the informational website, which 190 U.S. institutions have joined so far.



Success Story

Institutions that were not consortium members also benefited from the project. For example, a faculty member from the University of Iowa said, "[T]he power engineering classes that you and your department helped to establish are going like gangbusters here. . . ."

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PROJECT DURATION

7/30/2010–7/29/2014

COST

Total Project Value
$4,180,481

DOE/Non-DOE Share
$2,485,058/$1,695,423

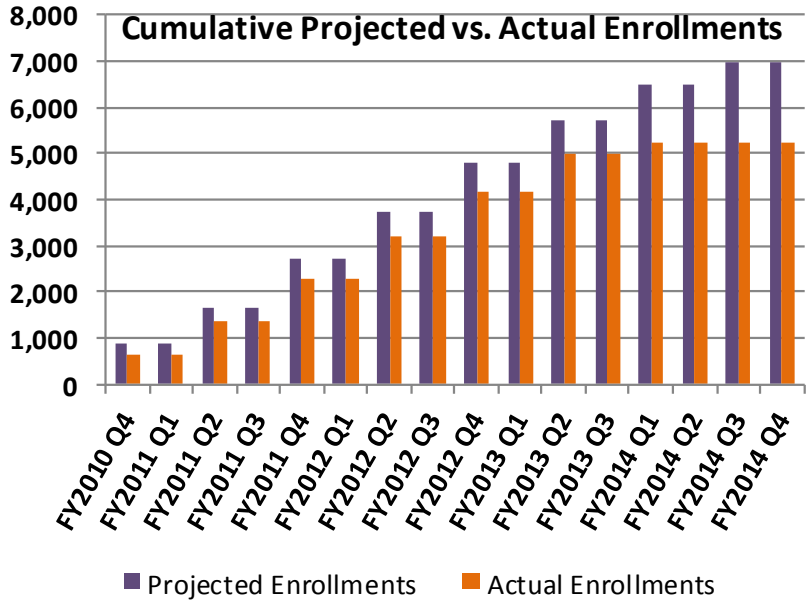
PROJECT LOCATION

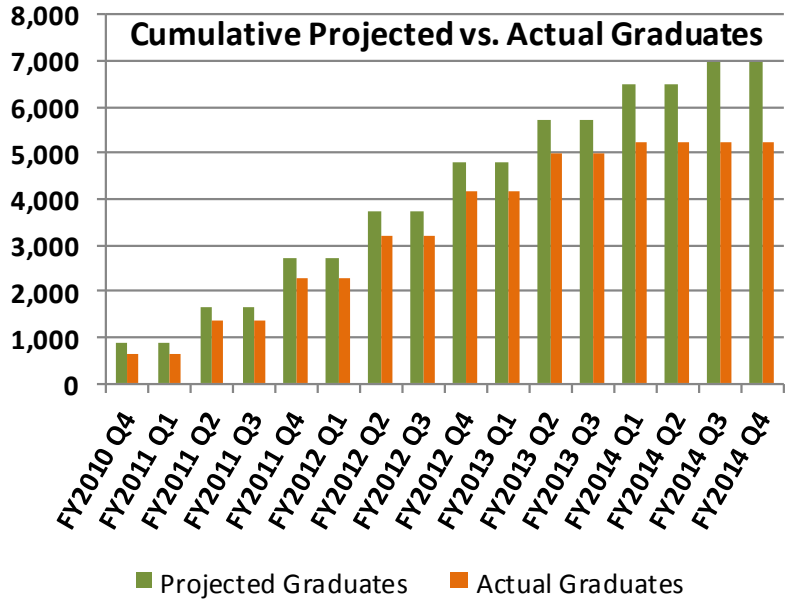
Minnesota
CID: OE0000427

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Undergraduate Program		**Train the Trainer Program**	
Projected Number of Enrollments	6,542	Projected Number of Enrollments	426
Actual Number of Enrollments	4,980	Actual Number of Enrollments	272
Projected Number of Graduates	6,542	Projected Number of Graduates	426
Actual Number of Graduates	4,980	Actual Number of Graduates	272





Salt Lake Community College

Workforce Training in Utah's Electric Power Sector

Project Description

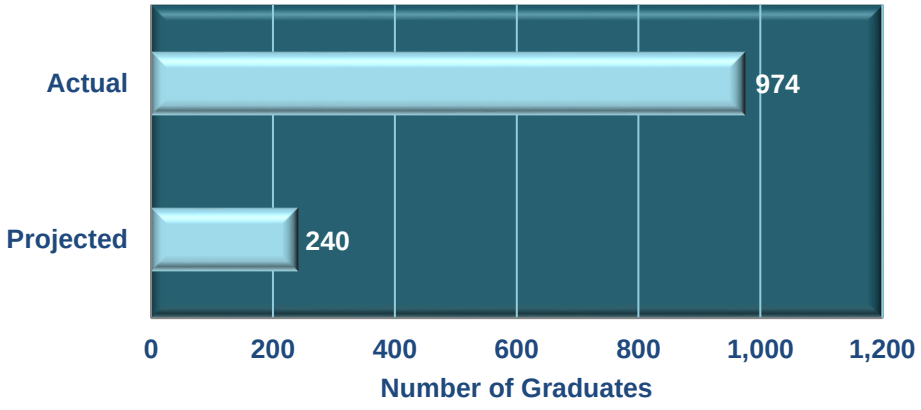
Salt Lake Community College (SLCC) and its partners provided training for electric power line installers and repairers, control valve installers and repairers, and power plant operators, fulfilling a critical need for workers trained in lineworker technology, including metering and substations. To enhance workforce skills, SLCC provided training on the introduction and integration of the smart grid.

Achievements

The project team developed and offered more than 2,400 hours of new training that related to lineworker, metering, and substation technology. An indoor pole yard and two outdoor pole yards provided hands-on learning environments and enabled industry "step" testing.

The team devised a new program, called Electric Power Technology, to give students a fundamental understanding of lineworker training. The program encompassed such courses as Basic Electricity for the Power Industry, Pole Climbing, Ropes and Rigging, and Electrical Distribution Systems. The program accommodated traditional students and incumbent workers alike by offering courses during the day and in the evening. Online classes also expanded the reach of the coursework. Among the incumbent workers who enrolled in the coursework, 950 received at least one industry certification—far surpassing SLCC's original certification goal. These 950 certified trainees include 34 apprentices who achieved journeyman status.

Furthermore, 32 new Continuing Education Unit (CEU) courses were developed with electricians, contractors, and engineers in mind. They covered insulation, windows, and doors; air leakage; lead-based paint; home air and water heating; and numerous other topics. Their development increased the number of CEU courses that SLCC offers by 70 percent.



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PARTNERS

Intermountain Power Superintendents' Association
Intermountain Power Agency
Utah Chapter AFL-CIO
Governor's Office of Economic Development
Utah Department of Natural Resources
Utah Department of Workforce Services

PROJECT DURATION

7/29/2010–9/30/2013

COST

Total Project Value
$1,031,911

DOE/Non-DOE Share
$614,240/$417,671

PROJECT LOCATION

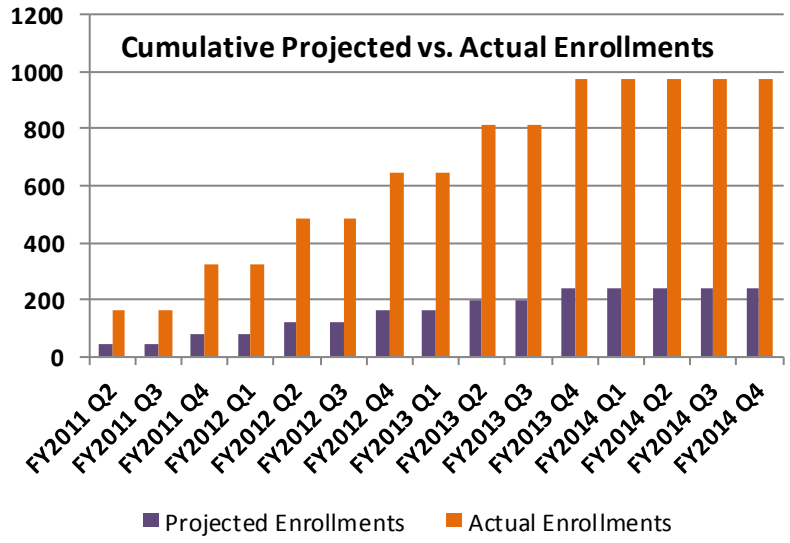
Utah

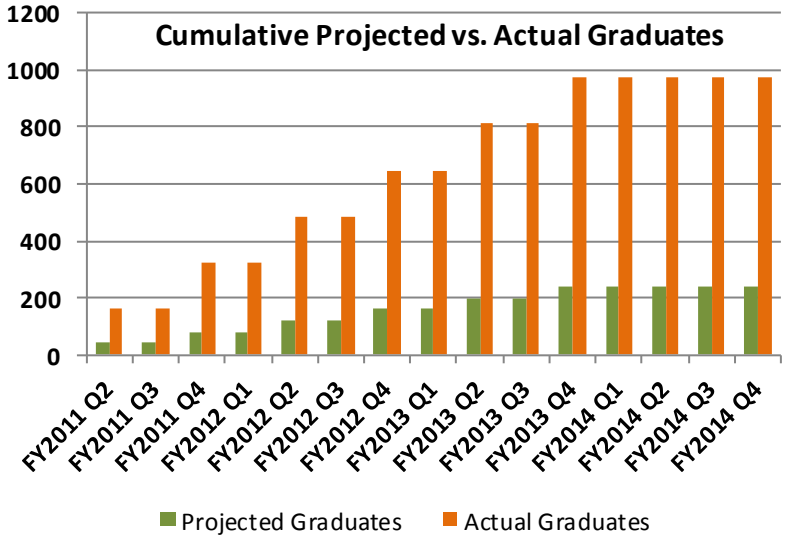
CID: OE0000457

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Technician Training Programs	
Projected Number of Enrollments	240
Actual Number of Enrollments	947
Projected Number of Graduates	240
Actual Number of Graduates	974





Salt Lake Community College
Utah's Smart Grid Training

Project Description

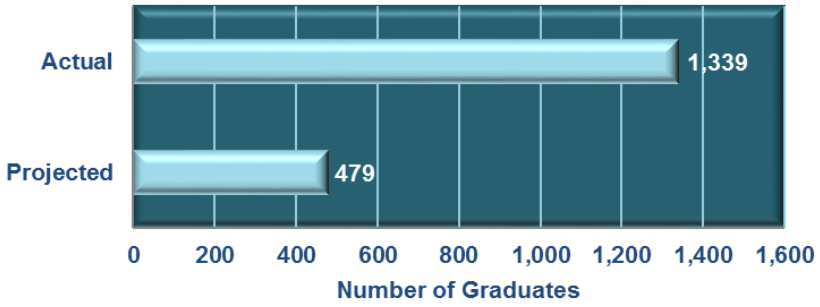
Salt Lake Community College (SLCC) provided training on the introduction and integration of the smart grid. Occupational training and placement activities focused on electric power line installer/repairer, control valve installer/repairer, power plant operator, utility energy efficiency technician, automation technician, efficiency measurement technician, and energy auditor jobs. SLCC targeted displaced workers as well as current and future electric power sector personnel. Workforce training was designed to help the state of Utah meet its energy and smart grid goals. Through the use of distance learning, SLCC increased its geographic reach to expand the capacity of a trained smart grid workforce.

Achievements

The project team developed and offered more than 2,400 hours of new training that related to lineworker, metering, and substation technology. An indoor pole yard and two outdoor pole yards provided hands-on learning environments and enabled industry "step" testing.

The team devised a new program, called Electric Power Technology, to give students a fundamental understanding of lineworker training. The program encompassed such courses as Basic Electricity for the Power Industry, Pole Climbing, Ropes and Rigging, and Electrical Distribution Systems. Because courses were offered during the day and in the evening, the program accommodated traditional students and incumbent workers alike. The Solar Photovoltaic curriculum was converted to an online format, and the solar yard was upgraded to include up-to-date equipment. Other Energy Sector courses (including Building Energy, Green Lighting Fundamentals, and RESNET/HERS Rater) were also converted to an online format.

Enrollments in the project's courses were more than double what SLCC expected. In addition, SLCC expected that 70 percent of the trainees who enrolled in the courses would complete them, but in actuality, more than 85 percent did. Furthermore, 32 new Continuing Education Unit (CEU) courses were developed with electricians, contractors, and engineers in mind. They covered photovoltaics; the Immigration Reform and Control Act; the Affordable Care Act; intellectual property; and numerous other topics. Their development increased the number of CEU courses that SLCC offers by 70 percent.



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PARTNERS

Smart Grid Energy Task Force
Governor of Utah's Office of Economic Development
Utah Department of Workforce Services

PROJECT DURATION

7/29/2010–9/30/2013

COST

Total Project Value
$3,053,899

DOE/Non-DOE Share
$1,523,005/$1,530,894

PROJECT LOCATION

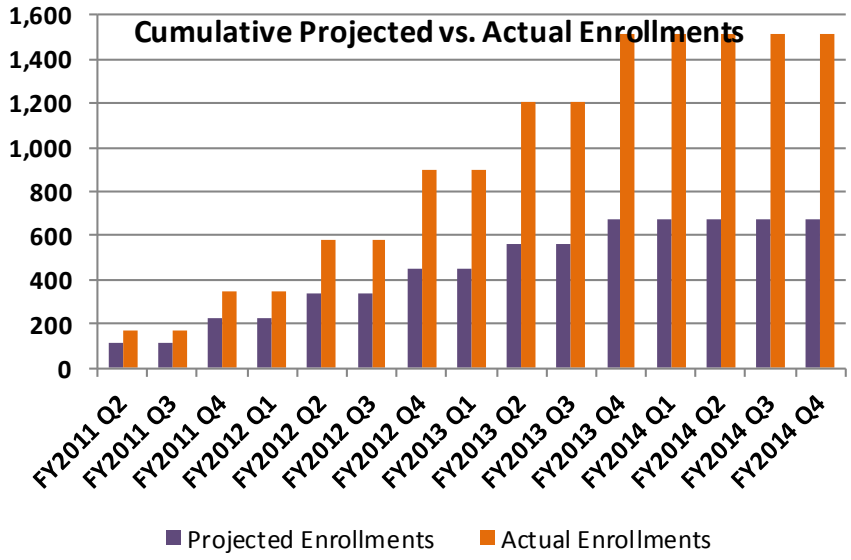
Utah

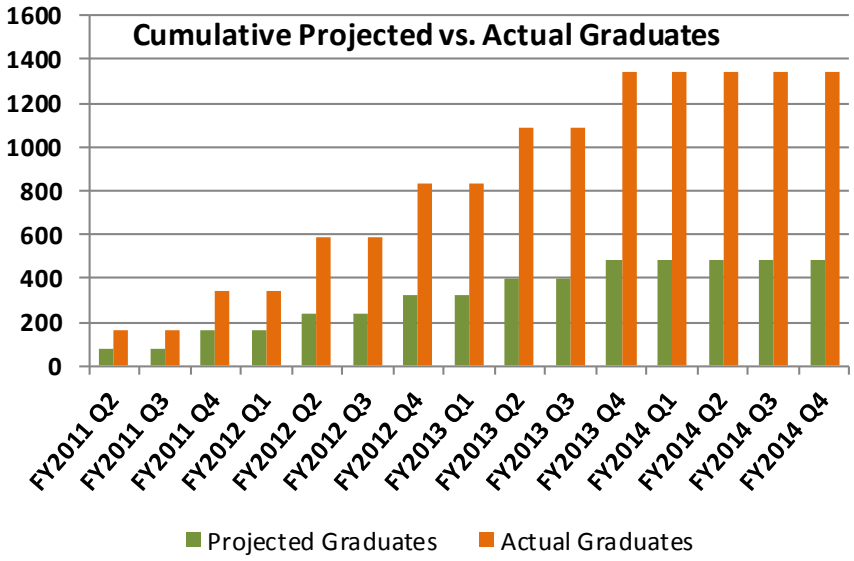
CID: OE0000458

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Training Program	
Projected Number of Enrollments	670
Actual Number of Enrollments	1,516
Projected Number of Graduates	479
Actual Number of Graduates	1,339





Savannah Technical College

Electric Utility Industry Workforce Development

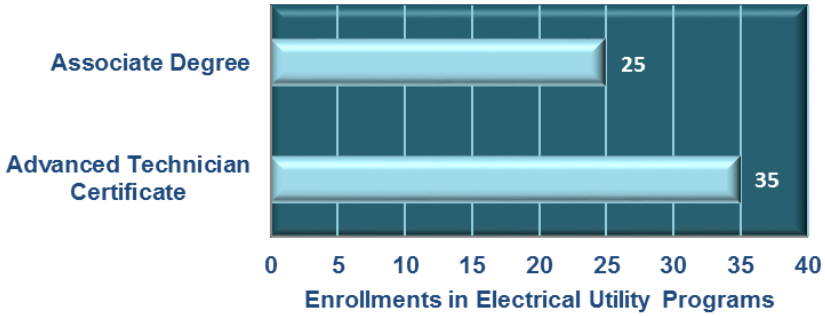
Project Description

Savannah Technical College, in collaboration with regional electric power companies and Savannah State University, developed and delivered courses in electrical utility technology to address the shortage of qualified utility technicians and mid-level technical personnel in Southeast Georgia and the South Carolina low country. The program included an advanced technician certificate track and an associate degree track. Incorporation of emerging trends differentiated this program through instruction on the smart grid, mini-grids, renewable energy, and utility tie-in of distributed sources. Training was incorporated into existing trade and apprenticeship programs.

Achievements

The curricula that Savannah Technical College developed as part of this project integrate general instruction in science, technology, engineering, and mathematics with more specific instruction in the electrical industry. Knowledge is imparted in multiple ways. Students enrolled in the curricula get the benefit of trade and apprenticeship programs, traditional academic programs, laboratory exercises, and 3-D virtual training models of power plants and substations.

Students pursuing an advanced technician certificate complete courses about computers, direct and alternating currents, the electrical utility industry, and network communications. Students working toward the associate degree in electrical utility technology complete those courses as well, but they also study distribution engineering, metering, power plants, and substations. Students on the associate degree track can, in addition, take courses that cover protection principles, transformers, renewable and alternative power sources, and smart grid technologies. Both of the curricula were so successful that Savannah Technical College has made them permanent, tuition-funded offerings.



Success Story

As a result of their experience in the associate degree program, two students found employment with an electrical contractor, and one student was hired by Georgia Pacific. All three students continue to pursue their associate degrees.

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PARTNERS

Savannah State University

PROJECT DURATION

8/6/2010–8/5/2013

COST

Total Project Value
$1,088,697

DOE/Non-DOE Share
$695,100/$393,597

PROJECT LOCATION

Georgia
South Carolina

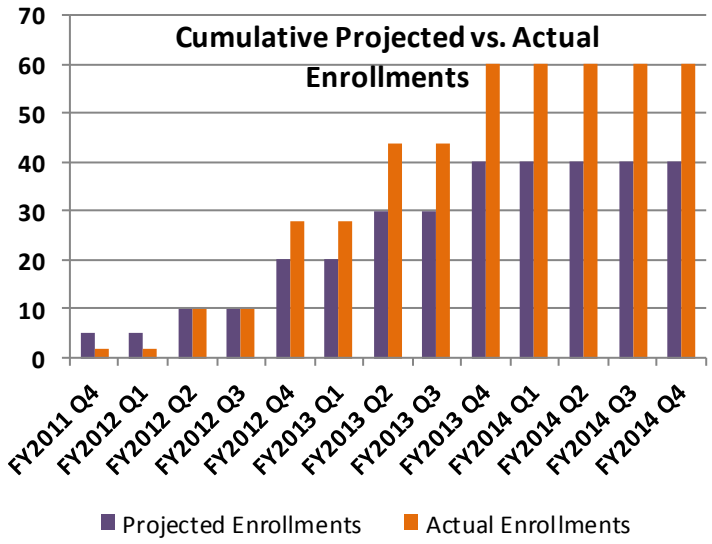
CID: OE0000476

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

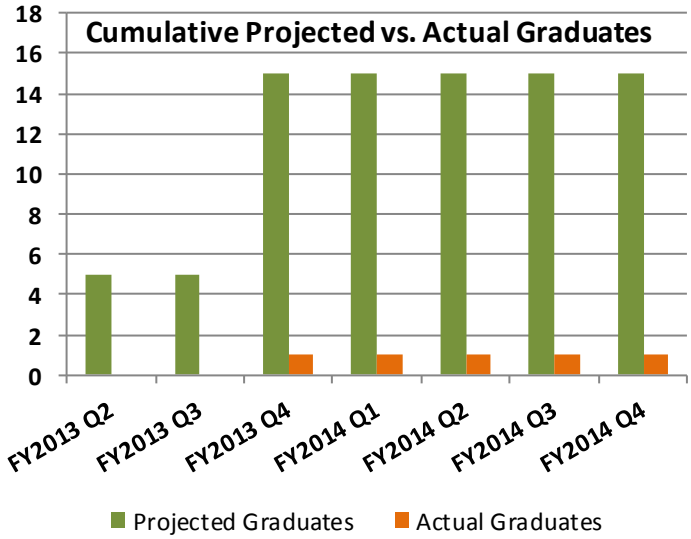
Metrics

Total Course Data			
Electrical Utility Advanced Technician Certificate		**Electrical Utility Associate Degree**	
Projected Number of Enrollments	25	Projected Number of Enrollments	15
Actual Number of Enrollments	35	Actual Number of Enrollments	25
Projected Number of Graduates	10	Projected Number of Graduates	5
Actual Number of Graduates	1	Actual Number of Graduates	0*

*Recipients were required to report graduates that occurred only during the project performance period of the grant. Due to delays in curriculum implementation, graduates were not realized in the Electrical Utility Associate Degree program.



Graduation rates did not meet projections during the grant period because curriculum development and implementation was delayed to hire project staff.



Syracuse University

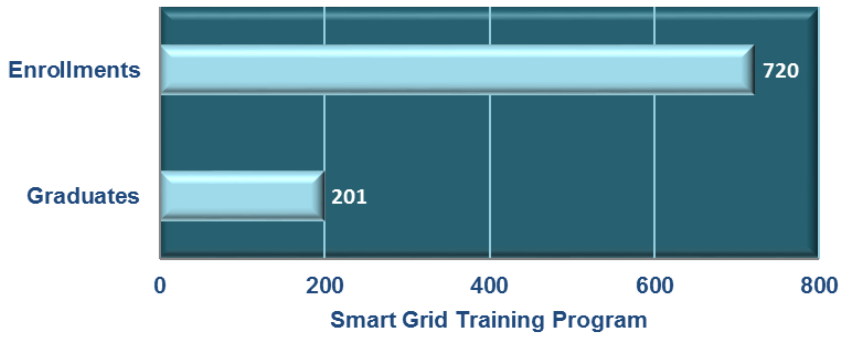
Multi-Institutional Curriculum Development and Delivery to Create the New Smart Grid Workforce

Project Description

Syracuse University and collaborating partners created an innovative curriculum to deliver regional and distance offerings of associate, undergraduate, and graduate degrees in smart grid technologies. The curriculum included a comprehensive spectrum of knowledge and skills—from smart grid basics, to the technical requirements associated with the design, security, and operation of communication and control devices. Courses were delivered in the classroom, online, and in cyber laboratories, and they included site visits to installations of smart grid components. The project team also established laboratories at SUNY Buffalo and Buffalo State College, Syracuse University, Onondaga Community College, Clarkson University, and the University of Rochester.

Achievements

The smart grid laboratory that the project team established at SUNY Buffalo and Buffalo State College fosters inter-institutional collaboration. It includes state-of-the-art equipment that allows students to study electricity fundamentals, transformers, renewables, and many other subjects. At Syracuse University, the new smart grid lab includes transmission lines, distribution feeders, programmable loads, and a microgrid with renewables. The smart home laboratory there was built partially by students and is equipped with wired and wireless communication systems. Finally, Syracuse's new power engineering lab enhances instruction on power electronics, sensors and measurements, and electromechanical devices. A smart grid lab was also established at Onondaga Community College, while at Clarkson University, a power system game, a relay lab, a fault simulator, and smart-grid-related case studies were implemented. At the University of Rochester, a power factor correction lab, a harmonics lab, an electric grid emulator, and wireless power monitors were employed.In addition to establishing laboratories, the project team developed courses that covered such topics as advances in grid infrastructure, smart grid security, monitoring and diagnostics, bulk power transmission systems, wireless networking, and modern power systems.



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PARTNERS

SUNY Buffalo
Buffalo State College
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University of Rochester
Onondaga Community College
National Grid

PROJECT DURATION

8/9/2010–8/8/2014

COST

Total Project Value
$2,995,458

DOE/Non-DOE Share
$2,461,378/$534,080

Project Location

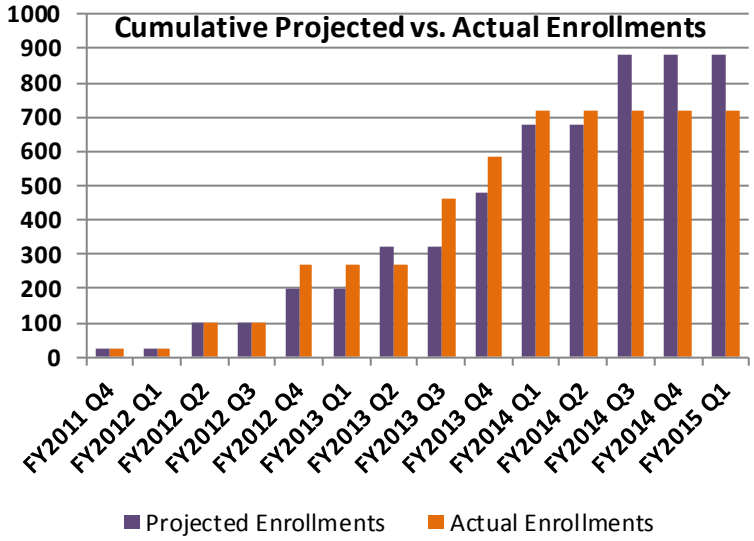
New York

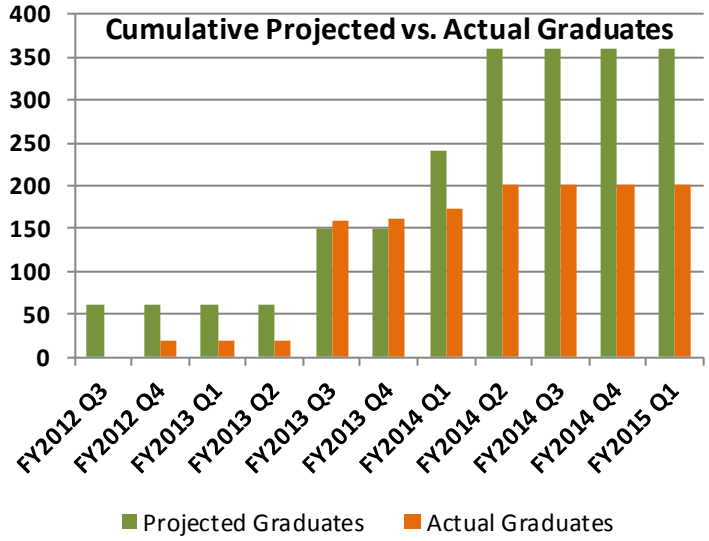
CID: OE0000495

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Smart Grid Training Program	
Projected Number of Enrollments	880
Actual Number of Enrollments	720
Projected Number of Graduates	360
Actual Number of Graduates	201





Pennsylvania State University

GridSTAR Center: Smart Grid Training and Application Resource Center

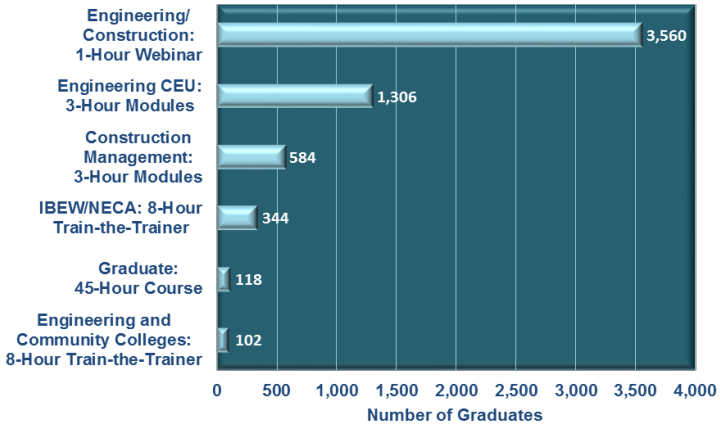
Project Description

The GridSTAR Center that Pennsylvania State University (Penn State) established provides smart grid education and workforce training. Three locations were pursued for operations: University Park, the Philadelphia Navy Yard, and Eaton's Power System Experience Center in Pittsburgh. Penn State coordinated with a diverse team of utility, energy management, manufacturing, and training partners to provide systems-based continuing education and train-the-trainer programs in advanced power systems design, energy economics, cyber security, distributed energy generation, and building-vehicle-grid systems.

Achievements

The GridSTAR Center at the Navy Yard includes microgrid infrastructure, enables smart grid demonstrations, and encompasses an energy storage system, electric vehicle charging infrastructure, and cyber security infrastructure. At University Park, a distance-education classroom and video-production lab were established, and a solar home was upgraded to support smart grid controls. Penn State pursued the temporary use of Eaton's Power System Experience Center, but future activities in Pittsburgh have been suspended, pending GridSTAR's capability to support expansion. The project team also created three online graduate courses: Distributed Energy Planning and Management, Commercial Solar Electric Systems, and Solar Energy Development and Finance.

The GridSTAR Center hosts smart grid workshops on a regular basis, along with manufacturer-conducted training. Bimonthly webinars are offered as well. An immersive summer program was offered at the GridSTAR Center in 2014, matching students with companies or organizations and giving them practical experience with photovoltaics and sustainable business practices. Penn State is considering making the program permanent, due to its initial success.



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PROJECT DURATION

8/5/2010–8/30/2014

COST

Total Project Value
$10,000,000

DOE/Non-DOE Share
$5,000,000/$5,000,000

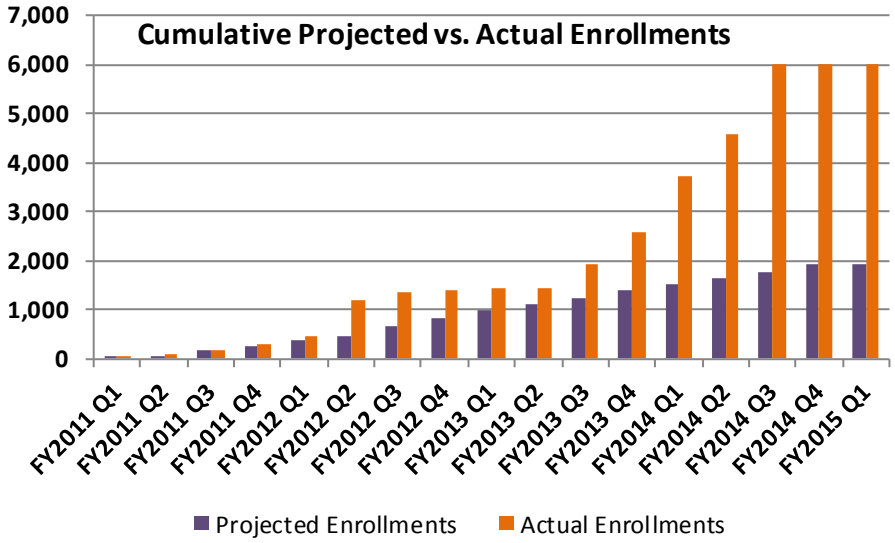
Project Location

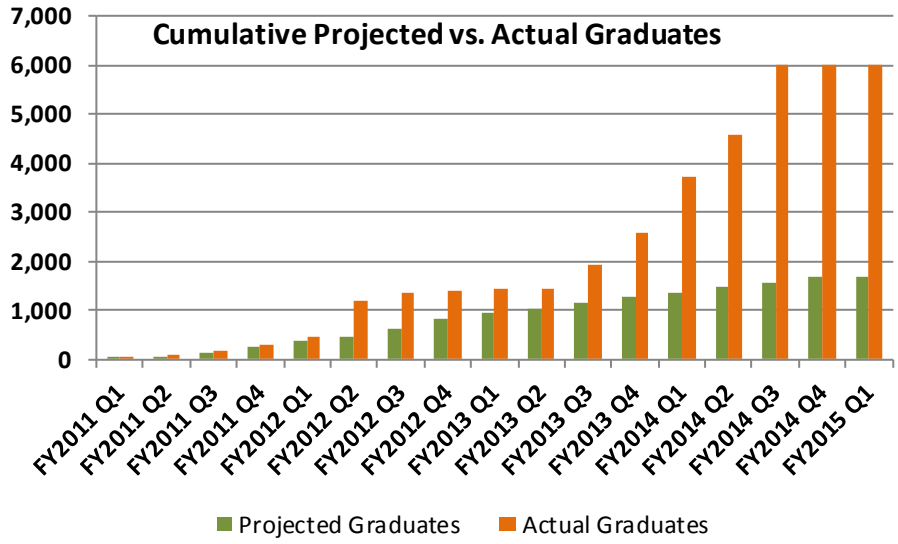
Pennsylvania
CID: OE0000506

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
Engineering and Community Colleges		**Engineering CEU: 3-Hour Modules**		**Engineering / Construction: 1-Hour Webinar**	
Projected Number of Enrollments	112	Projected Number of Enrollments	500	Projected Number of Enrollments	500
Actual Number of Enrollments	102	Actual Number of Enrollments	1,306	Actual Number of Enrollments	3,560
Projected Number of Graduates	112	Projected Number of Graduates	284	Projected Number of Graduates	500
Actual Number of Graduates	102	Actual Number of Graduates	1,306	Actual Number of Graduates	3,560
IBEW/NECA: 8-Hour Train-the-Trainer		**Graduate: 45-Hour Course**		**Construction Management: 3-Hour Modules**	
Projected Number of Enrollments	143	Projected Number of Enrollments	250	Projected Number of Enrollments	412
Actual Number of Enrollments	344	Actual Number of Enrollments	118	Actual Number of Enrollments	584
Projected Number of Graduates	143	Projected Number of Graduates	250	Projected Number of Graduates	387
Actual Number of Graduates	344	Actual Number of Graduates	118	Actual Number of Graduates	584





University Enterprises

California Smart Grid Workforce Development Network

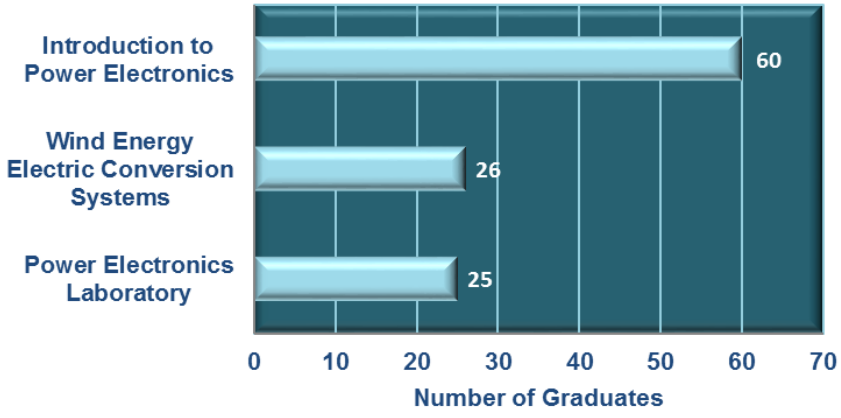
Project Description

The project team supported the development of California's smart grid workforce by training the workforce at electric utilities, California State University campuses, California community colleges, labor unions, and smart grid manufacturers in advanced power system technology. Before the project commenced, the partners had identified the need to train 897 incumbent engineers, 521 new-hire engineers, and 1,306 craft and technical workers over the next 5 years. In response, the project team created, executed, and altered a statewide workforce development strategy through degree and certificate programs by connecting smart grid technology advances to workforce needs. Two webinars were conducted to advance the professional development of professors and instructors at participating education locations.

Achievements

Based on ongoing discussions with partners from electric utilities, industry, and academia, the project team created a website that served as a workforce training clearinghouse. The project team also created and continually developed a California-wide workforce development strategy. A survey of utility workforce needs, technology rollout plans, and other subjects provided important insights. Webinars that the project team developed dealt with educational pathways. The project team, furthermore, built a strategic model that represents a comprehensive discussion of best practices for encouraging and enhancing training for a smart grid workforce.

Finally, the project team developed three courses: Introduction to Power Electronics, Power Electronics Laboratory, and Wind Energy Electric Conversion Systems. A hybrid course format—which combined in-person lectures with online presentations—was pursued to deepen the knowledge students gained from the coursework. The instructor continues to explore how best to balance in-person content with online content, in an effort to optimize learning in future semesters.



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Los Angeles Trade Tech
San Jose Evergreen
American River
California State University East Bay
California Smart Grid Center
California Energy Commission
California State University Sacramento

PROJECT DURATION

7/20/2010–9/19/2013

COST

Total Project Value
$833,343

DOE/Non-DOE Share
$749,992/$83,351

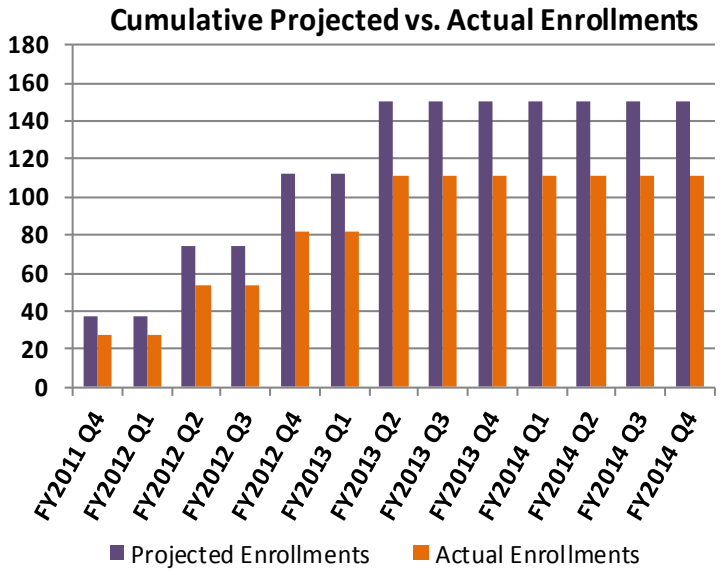
PROJECT LOCATION

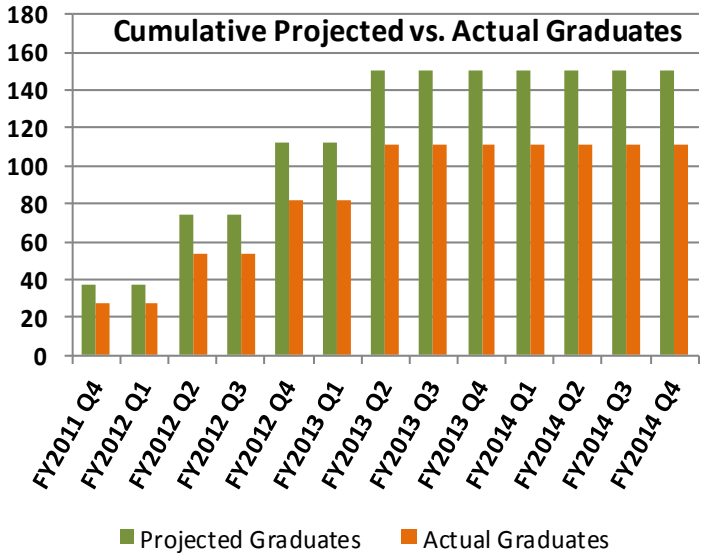
California
CID: OE0000492

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data					
Introduction to Power Electronics		**Power Electronics Laboratory**		**Wind Energy Electric Conversion Systems**	
Projected Number of Enrollments	70	Projected Number of Enrollments	40	Projected Number of Enrollments	40
Actual Number of Enrollments	60	Actual Number of Enrollments	25	Actual Number of Enrollments	26
Projected Number of Graduates	70	Projected Number of Graduates	40	Projected Number of Graduates	40
Actual Number of Graduates	60	Actual Number of Graduates	25	Actual Number of Graduates	26





University of Hawaii at Manoa

Integrated Education and Research in Clean Energy and Island Sustainability – Electric Power Sector Training

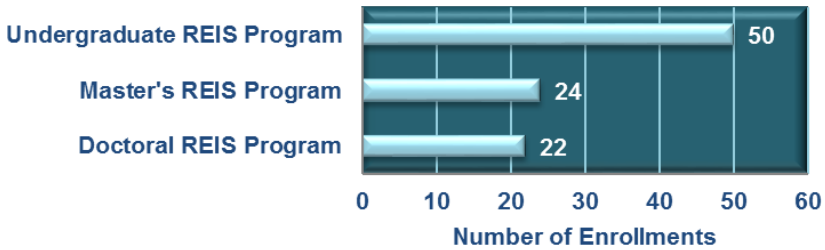
Project Description

This project created a cross-disciplinary program at the University of Hawaii Manoa (UHM) that included responsive and dynamic training coupled with foundational research-based curricula in clean energy technologies, renewable energy production, storage, grid integration, and smart grid technologies. The program leveraged industry expertise to train bachelor's-level, master's-level, and doctoral students in disciplines across the electricity and power sectors. Students learned through coursework, labs, research projects, and rotational training. Special attention was given to integrating renewable energy into the Hawaiian Islands' isolated grid.

Achievements

UHM offered core graduate-level coursework that focused on energy and economics. In particular, two graduate-level courses were created: Renewable Energy and Sustainability Engineering, and Renewable Energy Economics and Policy. Graduate students were engaged in research projects that dealt not only with smart grids, energy harvesting, and devices used in generating and storing energy; they also researched ways to monitor energy use, analyze energy economics, and develop bioenergy products. On the undergraduate level, students were given the opportunity to research energy and sustainability and to enroll in new courses in the power and energy areas.

Furthermore, the certificate in Renewable Energy and Island Sustainability (REIS) encompassed such courses as Project Evaluation and Resource Management, Undergraduate Renewable Energy, Power Systems Analysis, and Solar Decathlon. It also included seminars where guest speakers discussed nanotechnology's applications to renewable energy storage and generation, the renewable energy program at Hawaiian Electric Company Inc., and sea level changes and coastal sustainability, to name but three topics.



Success Story

Graduate students who participated in the program have gone on to work at Pearl Harbor, Rockwell Automation, Raytheon, and InCube Labs, among other places.

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PARTNERS

Hawaiian Electric Company Inc.

PROJECT DURATION

5/4/2010–6/30/2014

COST

Total Project Value
$2,777,778

DOE/Non-DOE Share
$2,500,000/$277,778

PROJECT LOCATION

Hawaii

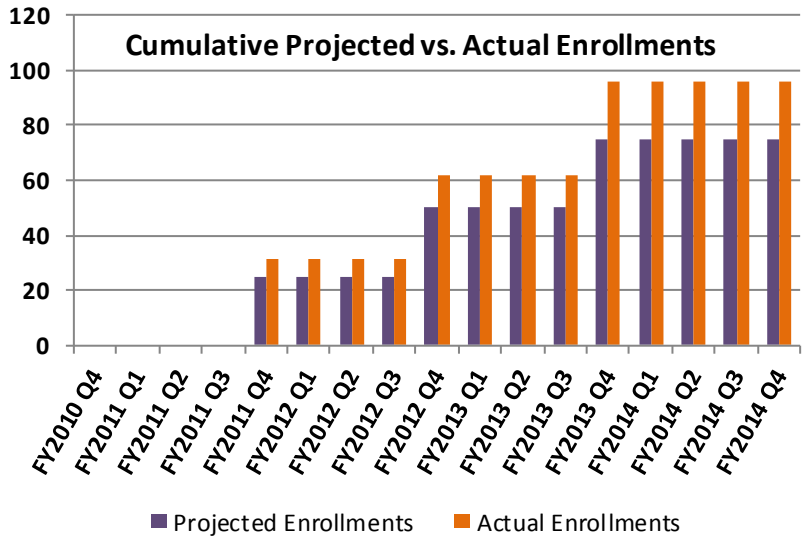
CID: OE0000394

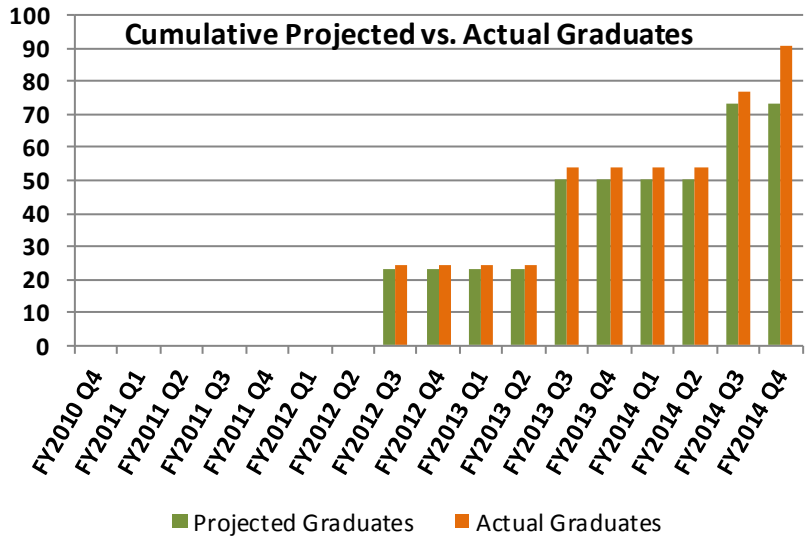
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Undergraduate CEIS Program		**Master's Degree CEIS Program**	
Projected Number of Enrollments	45	Projected Number of Enrollments	24
Actual Number of Enrollments	50	Actual Number of Enrollments	24
Projected Number of Graduates	45	Projected Number of Graduates	24
Actual Number of Graduates	50	Actual Number of Graduates	21

Ph.D. CEIS Program	
Projected Number of Enrollments	6
Actual Number of Enrollments	22
Projected Number of Graduates	4
Actual Number of Graduates	20





University of Hawaii Systems
Pacific Center for Advanced Technology Training

Education and Research in Clean Energy and Island Sustainability

Project Description

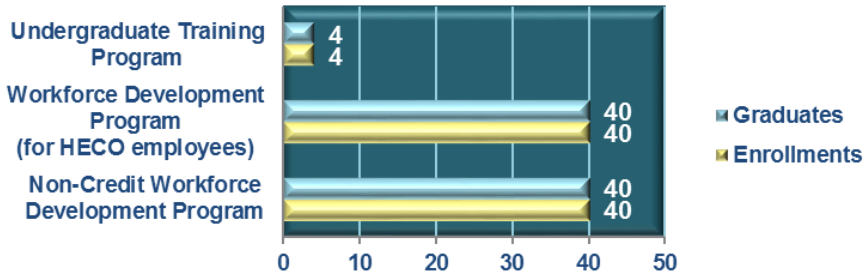
The University of Hawaii Community College System (UHCC) developed a curriculum for technicians who deploy and maintain electric power transmission and distribution through the application of smart grid technologies. The curriculum gave participants a working knowledge of generation, transmission, and distribution topics. The training program also included the development of problem-solving skills for lineworkers, technicians, system planners, reliability coordinators, control room operators, and control system administrators.

Achievements

The curriculum provided a path leading from high school graduation to a career as a smart grid technician. The curriculum encompassed industry-certified courses as well, which were used to train displaced workers, incumbent workers, and nontraditional students. Participants could earn an associate of science in intelligent energy systems or an associate of applied science in intelligent energy systems. They also had the option to pursue certificates of achievement in two areas: power transmission, distribution, and control systems; and networking and advanced metering infrastructure. A certificate of completion in intelligent energy systems was an additional possibility.

HUCC worked with representatives from the electric utility industry, subject matter experts, educational specialists and administrators, and program management personnel to ensure that the new and modified coursework would help alleviate the projected shortfall in the energy workforce. More specifically, HUCC designed its coursework to prepare employees of the Hawaiian Electric Company (HECO) for the implementation of HECO's smart grid projects.

The course's impact, however, goes beyond Hawaii. As part of HUCC's effort to disseminate the curriculum nationally, HUCC has partnered with the California Community College System and York Technical College in Rock Hill, South Carolina, to deploy the curriculum at those institutions. In addition, a presentation on the project was given at the National Coalition of Advanced Technology Centers' 2013 Fall Conference in Panama City, Florida.



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PARTNERS

Siemens
Leeward Community College
Hawaiian Electric Company

PROJECT DURATION

7/30/2010–7/31/2013

COST

Total Project Value
$882,956

DOE/Non-DOE Share
$750,000/$132,956

PROJECT LOCATION

Hawaii

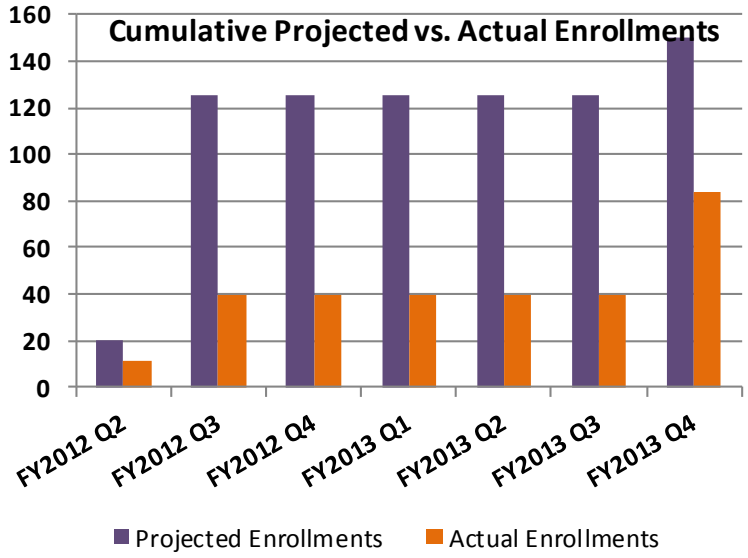
CID: OE0000430

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

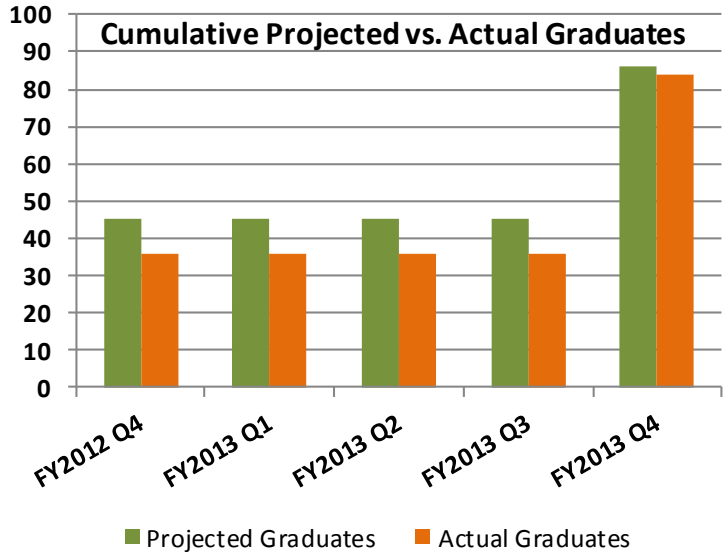
UNIVERSITY OF HAWAII SYSTEMS

Metrics

Total Course Data					
Non-Credit Workforce Development Program		**Workforce Development Program**		**Undergraduate Level Training Program**	
Projected Number of Enrollments	50	Projected Number of Enrollments	20	Projected Number of Enrollments	80
Actual Number of Enrollments	40	Actual Number of Enrollments	40	Actual Number of Enrollments	4
Projected Number of Graduates	50	Projected Number of Graduates	20	Projected Number of Graduates	16
Actual Number of Graduates	40	Actual Number of Graduates	40	Actual Number of Graduates	4



The overstatement of employment need and the time required to complete the curriculum contributed to this low training outcome. The timing of this 2-year curriculum development project resulted in the completion of the curriculum in 2012 and the preparation for offering the program beginning in 2013.



University of Houston

Smart Grid Energy Training Coalition

Project Description

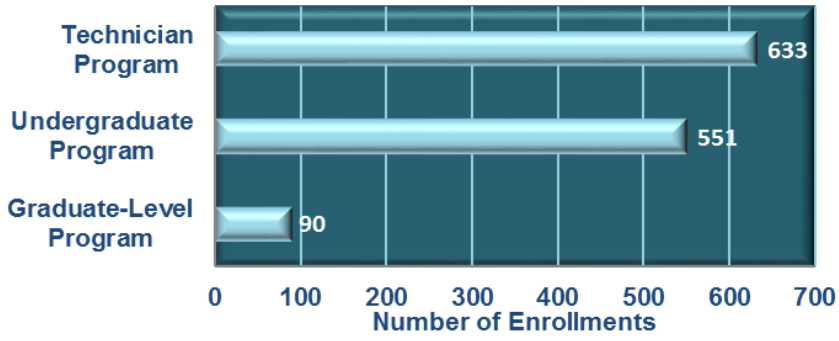
The project team created a distributed set of resources and capabilities that provide a regional focal point for education and training in the emerging clean energy smart grid. The team established the MIAT Power Technology Institute (MIAT/PTI) training facility and, at the University of Houston, a mid-grid laboratory. The education and training programs developed as part of the project enable cross-fertilization of the technical fields that comprise the new capabilities required by modern electric power sector employees. New areas of collaboration and research on information systems security, electric power, smart building technology, and skills analysis have been established.

Achievements

The programs that the project team developed and enhanced reflect input from CenterPoint Energy leadership and management, the Center for Energy Workforce Development, the Texas Workforce Commission, and other sources. These programs include Power Generation Technician, Relay Technician, Power Plant Operator, and Wind Technician Programs offered at the MIAT/PTI training facility. They also include a revised bachelor's-level program in electric power engineering technology offered at the University of Houston. Three lecture courses and one laboratory course that are part of the bachelor's-level program were modified to address smart grid technologies. Other courses in electrical engineering were augmented as well; they now include sensor network content appropriate to smart grid and energy management.

Furthermore, a graduate-level course in industrial control systems security was developed for the University of Houston. It covers such topics as threat vectors to control systems, security standards and policies, system vulnerability assessment, and tools for monitoring control systems' vulnerabilities and security events. Because the programs were designed to be self-sustaining, they will continue to have positive effects well into the future.

In addition, CenterPoint Energy provided employee training as part of the project. This training encompassed the following courses: Intelligent Grid First Responder Training, Intelligent Grid Troubleshooting, and Distribution Apprentice Training.



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PARTNERS

CenterPoint Energy
San Jacinto College
Power Technology Institute
SkillsNET
Texas Business and Education Coalition

PROJECT DURATION

8/1/2010–12/31/2014

COST

Total Project Value
$3,697,438

DOE/Non-DOE Share
$2,468,987/$1,228,451

PROJECT LOCATION

Texas

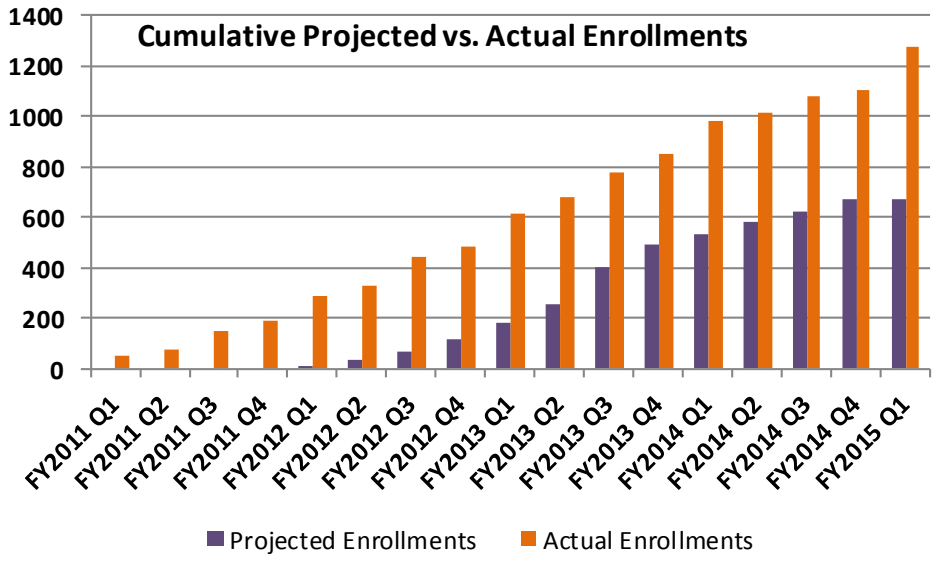
CID: OE0000485

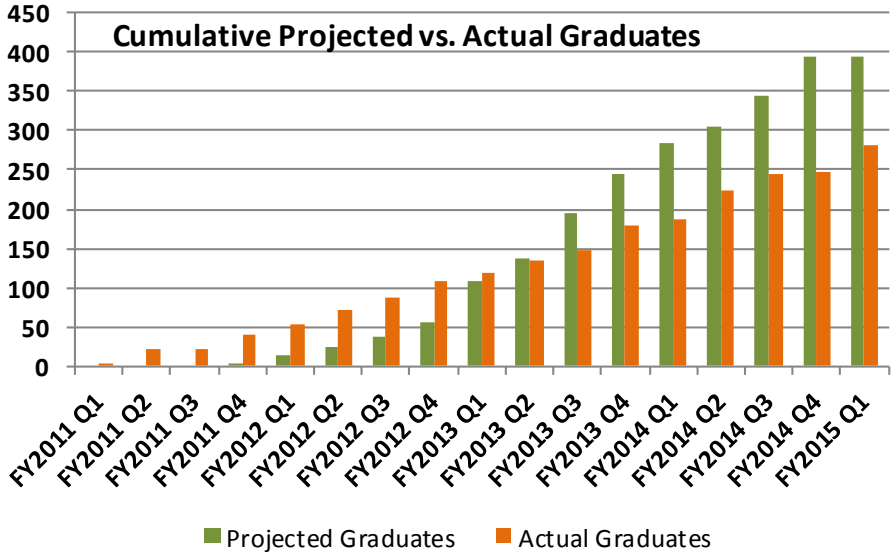
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Undergraduate Degree		**Technician**	
Projected Number of Enrollments	80	Projected Number of Enrollments	295
Actual Number of Enrollments	551	Actual Number of Enrollments	633
Projected Number of Graduates	80	Projected Number of Graduates	95
Actual Number of Graduates	132	Actual Number of Graduates	149
Advanced Certificate		**Associates Degree**	
Projected Number of Enrollments	135	Projected Number of Enrollments	160
Actual Number of Enrollments	90	Actual Number of Enrollments	0*
Projected Number of Graduates	60	Projected Number of Graduates	160
Actual Number of Graduates	0*	Actual Number of Graduates	0*

*Recipients were required to report projected enrollments and graduates that occurred only during the project performance period of the grant. Due to delays in detailing of industry training requirements for Smart Grid job requirements, there were no enrollments and graduates realized in these programs during the period of performance.





Delays in the detailing of industry training requirements for Smart Grid job requirements has resulted in a delay of training at the Associates Degree, Undergraduate Degree and Advanced Certificate levels. The projections are the recipient's plan for future results in these areas and could still be impacted by the validation of skill requirements.

University of Kentucky

Power and Energy Education Institute

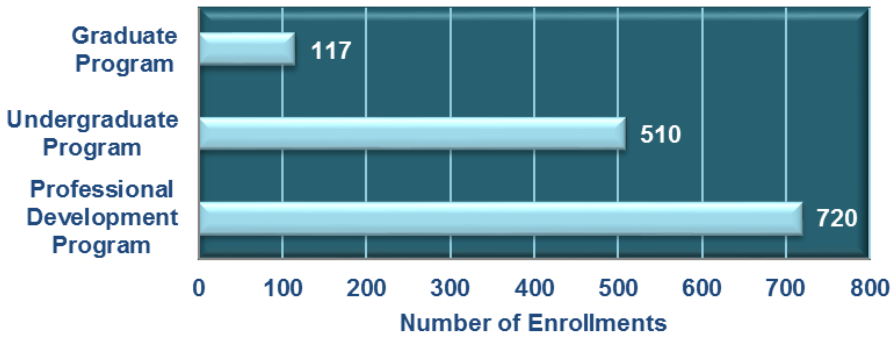
Project Description

The University of Kentucky Research Foundation created the Power and Energy Institute of Kentucky (PEIK) at the College of Engineering. In close collaboration with industry, PEIK combines existing power engineering courses with newly created ones. PEIK coordinates with relevant courses in other engineering and non-engineering fields to provide students with an attractive, clear pathway into the power engineering workforce. Students who participate in PEIK can work toward a baccalaureate certificate, a graduate certificate, or a professional-development certificate.

Achievements

With PEIK, the University of Kentucky has been able to offer an undergraduate certification program that gives students a firm understanding of the principles that underlie power and energy. The undergraduate program also gives students knowledge that is particular to smart grid systems, distributed generation, system protection, and other areas. The graduate certification program offers—in addition to classroom instruction on advanced topics—trips to energy-related sites, such as a biofuels facility, a wind farm, a landfill gas site, and a smart grid demonstration center. So far, 54 undergraduate certificates and 60 graduate certificates have been awarded.

The courses associated with PEIK cover subjects from the fundamentals of electric power systems, to global energy issues, to the economics and public policies that influence power systems. In particular, PEIK has engendered many special-topics courses, including ones that focus on the environmental consequences of energy production, the automation and control of power systems, rotodynamics, and solar power. PEIK also maintains a series of professional-development seminars on current energy issues. Seminar speakers represent government agencies, the electricity industry, and academia, addressing such topics as utility regulations, bulk electric transmission, East Kentucky Power Cooperative's air quality systems, and Kentucky's energy landscape. The seminar series has proven especially popular, attracting more than 700 attendees. By providing workshops, seminars, and coursework relevant to 21st-century energy systems, PEIK is preparing students and professionals to launch or accelerate their careers in the energy industry.



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PARTNERS

None Listed

PROJECT DURATION

5/4/2010–5/13/2014

COST

Total Project Value
$3,011,921

DOE/Non-DOE Share
$2,496,891/$515,030

PROJECT LOCATION

Kentucky

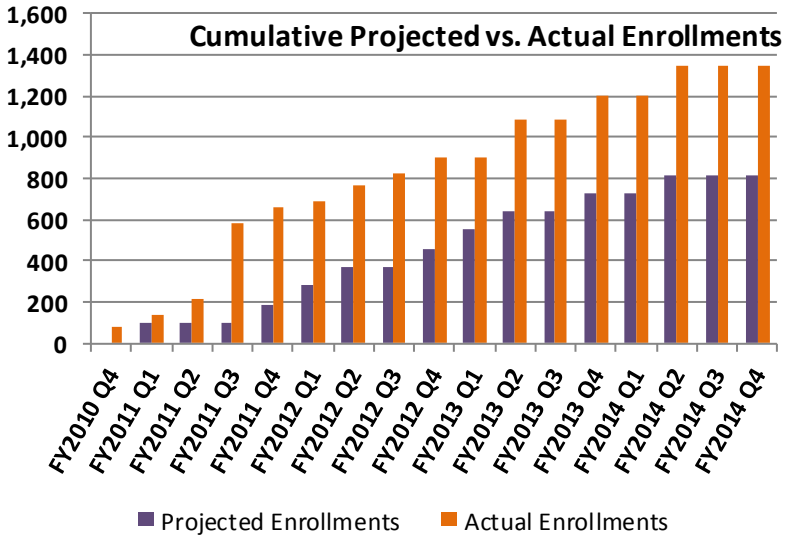
CID: OE0000409

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

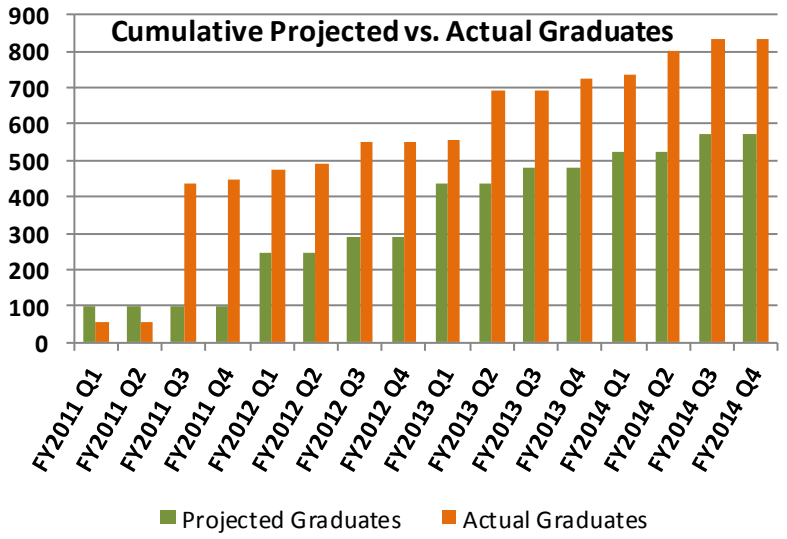
UNIVERSITY OF KENTUCKY

Metrics

Total Course Data					
Professional Development Program		**Undergraduate Program**		**Graduate Program**	
Projected Number of Enrollments	300	Projected Number of Enrollments	300	Projected Number of Enrollments	210
Actual Number of Enrollments	720	Actual Number of Enrollments	510	Actual Number of Enrollments	117
Projected Number of Graduates	300	Projected Number of Graduates	150	Projected Number of Graduates	120
Actual Number of Graduates	720	Actual Number of Graduates	54	Actual Number of Graduates	60



Enrollments are counted as students that took a minimum of 3 courses in the power and energy area. However, from Summer 2010 through Spring 2014, a total of 1,851 students took at least one course.



Graduates from the undergraduate and graduate programs were counted as those students that received a certificate, which required completion of at least 5 courses in power and energy. Actual graduates are less than projected graduates for these two programs because the certificates were not approved by the University until April 2013.

University of Tennessee, Chattanooga
Workforce Training for the Electric Power Sector

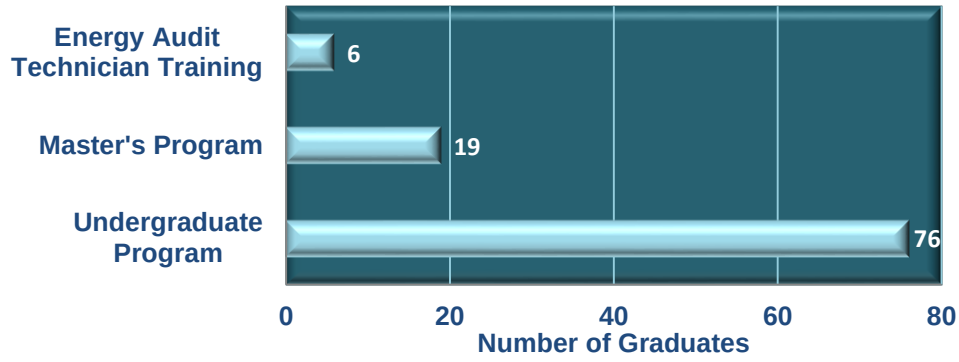
Project Description

The University of Tennessee at Chattanooga (UTC) trained current and future workers across a variety of educational levels. For middle schools and high schools, UTC trained teachers about power technology to draw more future workers into the industry. Power-related electives permitted undergraduate students to specialize in high-demand technologies. Engineers benefited from training in modern power systems through a master's program, short courses, and seminars. Additionally, certificate programs were developed for students as well as professionals.

Achievements

By the end of 2013, 360 students had taken the energy system course that UTC developed for middle- and high-schoolers. Seven undergraduate courses were launched at UTC and Chattanooga State Community College (CSCC), covering power electronics and the smart grid, among many other topics. Two undergraduate courses, Power System Relaying and Power Systems Analysis & Design, were enhanced. On the graduate level, six new courses (including courses in mobile broadband, network communication, and transients in power systems) were offered. Five modified graduate courses dealt with power systems, digital relays, and advanced digital design. To give students the benefit of hands-on learning, UTC upgraded its Smart Grid and Protection Laboratory and created three more labs to support the coursework. For its part, CSCC began offering control-room-operator training and A.A.S. degrees in power systems and renewable energy technology.

UTC's project encompassed five new certificates—in sustainable electric energy, power system protection, power system distribution, the smart grid, and power system management. It also included 21 seminars and 12 short courses targeted at employed technicians and displaced workers. By offering a broad range of educational options, holding electricity-industry job fairs, and awarding electrical-engineering scholarships to UTC and CSCC students, UTC and its partners reached out to utility workers—both present and potential—and prepared them to fill gaps in the energy industry.



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PARTNERS

Chattanooga State Community College
Tennessee Valley Authority
Chattanooga Electric Power Board
Institute of Electrical and Electronics Engineers
Hamilton County Department of Education
Southeast Tennessee Development District

PROJECT DURATION

6/28/2010–6/27/2014

COST

Total Project Value
$2,639,170

DOE/Non-DOE Share
$2,316,768/$322,402

PROJECT LOCATION

Tennessee

CID: OE0000413

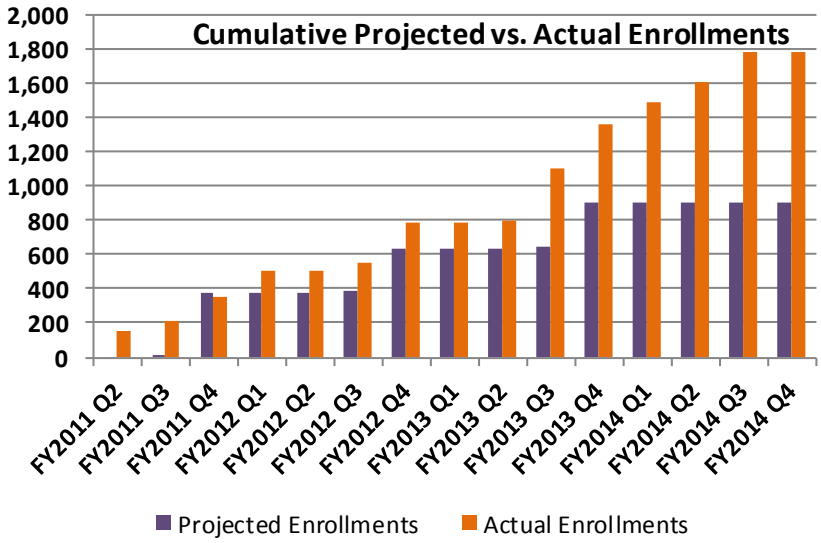
Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

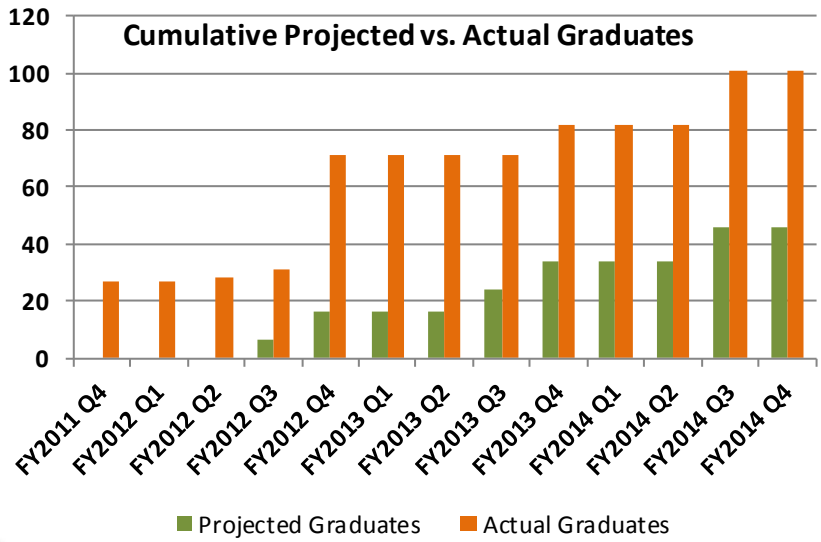
Metrics

Total Course Data					
Undergraduate Program		**Energy Audit Technicians (Trades)**		**Seminars**	
Projected Number of Enrollments	30	Projected Number of Enrollments	20	Projected Number of Enrollments	765
Actual Number of Enrollments	442	Actual Number of Enrollments	6	Actual Number of Enrollments	937
Projected Number of Graduates	14	Projected Number of Graduates	20	Projected Number of Graduates	0*
Actual Number of Graduates	76	Actual Number of Graduates	6	Actual Number of Graduates	0*

Short Courses		**Masters Program**	
Projected Number of Enrollments	60	Projected Number of Enrollments	28
Actual Number of Enrollments	344	Actual Number of Enrollments	63
Projected Number of Graduates	0*	Projected Number of Graduates	12
Actual Number of Graduates	0*	Actual Number of Graduates	19

*There are no graduates projected or reported for programs because Seminars and Short courses do not inherently produce graduates.





The difference between the enrollments and graduates is due to the fact that many of the programs offered by UT-Chattanooga, as part of this project, were Short Courses, Brief Seminars, and K-12 outreach programs that did not inherently produce graduates. However, employees of local industry that attended the seminars and short courses did receive continuing education credits and professional development hours for their participation.

Washington State University

Training in Clean Energy Smart Grid Engineering

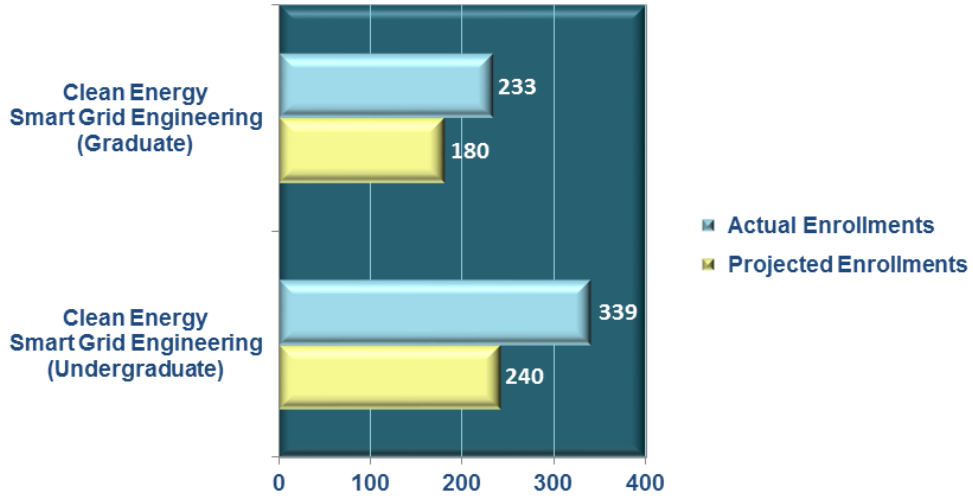
Project Description

Washington State University, in collaboration with 11 partners, developed and delivered six undergraduate courses and 12 graduate courses in smart grid engineering. Most of the course development was done at Washington State University and the University of Washington, but specialized parts of the courses were developed by Pacific Northwest National Laboratory, Incremental Systems, Areva T&D, and the Bonneville Power Administration. Other organizations reviewed courseware, participated in the courseware's initial delivery, and assessed courses.

Achievements

The undergraduate courses that the project fostered covered power engineering fundamentals, renewable energy generation, power electronics and digital systems for the smart grid, and smart grid protection and control. The graduate courses were divided into four categories—clean energy generation technologies, smart grid technologies, smart grid planning, and smart grid operation—and dealt with such topics as transmission and distribution, the integration of new energy sources, the economics behind electric energy, and generation resource scheduling, among many others.

Approximately 20 percent of the students who enrolled in the courses did so for certification; the other 80 percent audited the courses. The courses were offered online to engineers at several utilities in the Northwest. Course material was also developed for military veterans seeking power system operator training. Moreover, in the fall of 2014, Washington State University went on to offer the nation's first online professional science master's degree in electric power engineering, building on the initial success of the project. The new master's program is appropriate for newly hired electric utility engineers who do not yet have an extensive technical background in the field.



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PARTNERS

University of Washington
Pacific Northwest National Labs
Incremental Systems Inc.
Areva T&D
Bonneville Power Administration
Avista Utilities
Puget Sound Energy
Tacoma Power
Snohomish PUD
Schweitzer Engineering Laboratories
Northwest Public Power Association

PROJECT DURATION

8/1/2010–7/31/2013

COST

Total Project Value
$3,955,619

DOE/Non-DOE Share
$2,233,791/$1,721,828

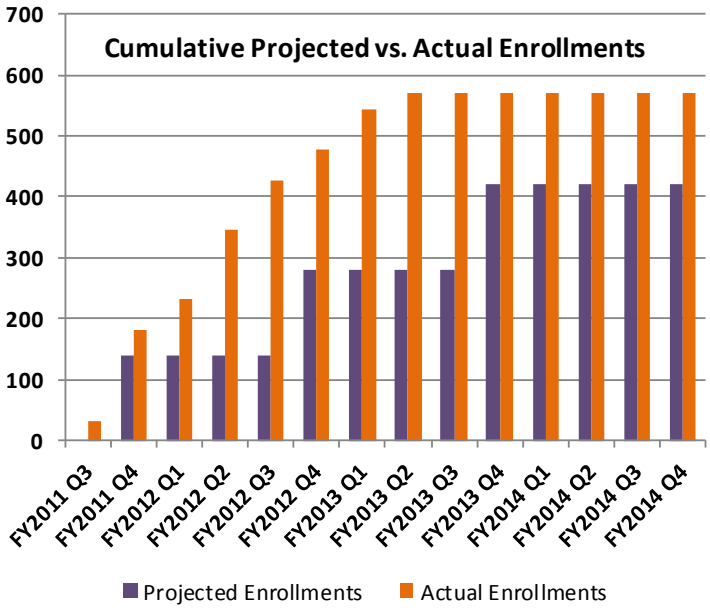
PROJECT LOCATION

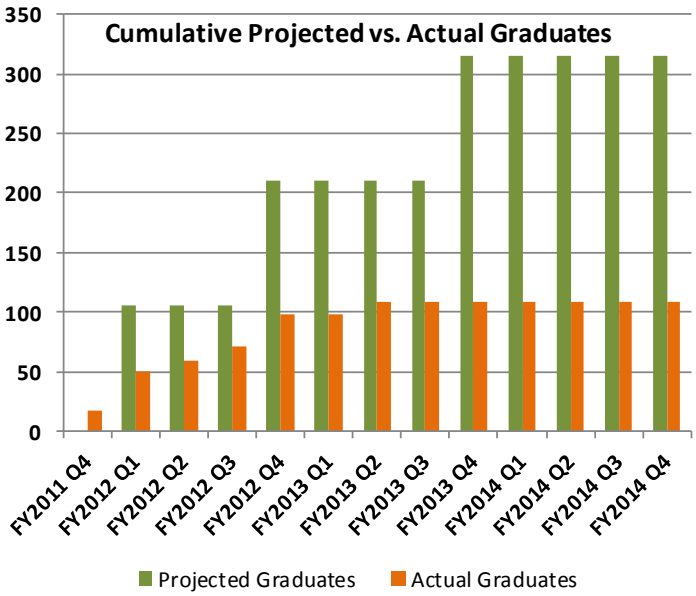
Washington
CID: OE0000486

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data			
Undergraduate Program		**Graduate Program**	
Projected Number of Enrollments	240	Projected Number of Enrollments	180
Actual Number of Enrollments	339	Actual Number of Enrollments	233
Projected Number of Graduates	180	Projected Number of Graduates	135
Actual Number of Graduates	53	Actual Number of Graduates	56





It appears that providing these courses to students completely free of charge reduced their commitment to complete the courses. This is the reason why the number of students who registered for the courses was far greater than the number of students who completed the courses. This experience is consistent with universities who have offered massively online open courses (MOOCs).

Workforce Development Institute Inc.

Development of a Smart Grid Lineman Workforce

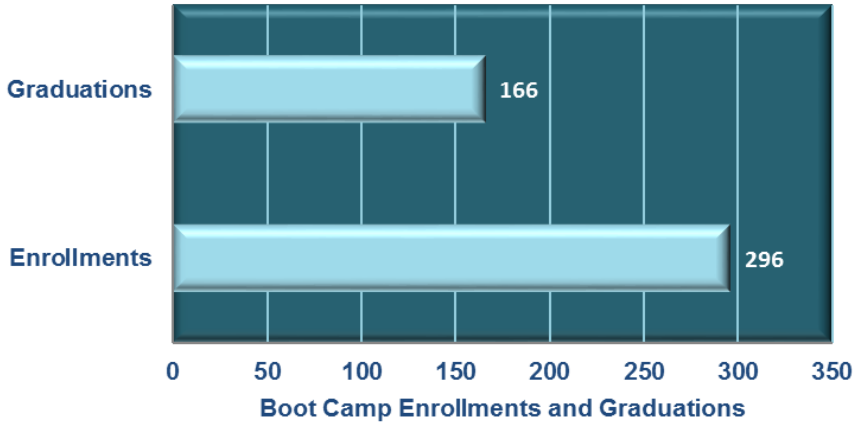
Project Description

The Workforce Development Institute Inc. (WDI) provided a training program to ensure that adequate numbers of linemen are trained and available to install, maintain, and support the New York State electric power sector. The program imparted skills needed to support smart grid implementation. WDI's project fostered new apprenticeship positions and established a career path that led to journeyman status. WDI also trained current lineworkers (journeymen, apprentices, groundhands, splicers, and equipment operators) with adequate knowledge for job retention and implementation of the smart grid. Trainees were immediately placed in jobs upon program completion.

Achievements

In collaboration with its project partners, WDI held 16 boot camps attended by a total of 296 apprentice recruits. Enrollment in each boot camp ranged from nine to 26 recruits. The boot camps emphasized safe work practices and included classes on basic life support, bucket rescue and pole-top rescue, CPR and first aid, work in confined spaces, climbing, DC theory, hot sticks, transformers, insulate grounding, pole framing and setting, and regulations mandated by the Occupational Safety and Health Administration. The boot camps also prepared students to take Northeastern Joint Apprenticeship Training Committee (NJATC) aptitude testing and pursue the NJATC rigger/signal person qualification.

Although dropout rates were higher than expected, the apprentices who enrolled in and completed the boot camps became journeymen and were recruited for positions through the International Brotherhood of Electrical Workers (IBEW). By working with IBEW Locals, WDI made certain that the number of apprentices who enrolled in the boot camps equaled—or neared—the number of workers who could find prompt employment in New York State's electric industry.



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PARTNERS

International Brotherhood of Electrical Workers
Northeastern Joint Apprenticeship Training Committee
National Electrical Contractor's Association

PROJECT DURATION

7/30/2010–6/30/2014

COST

Total Project Value
$3,116,872

DOE/Non-DOE Share
$1,558,436/$1,558,436

PROJECT LOCATION

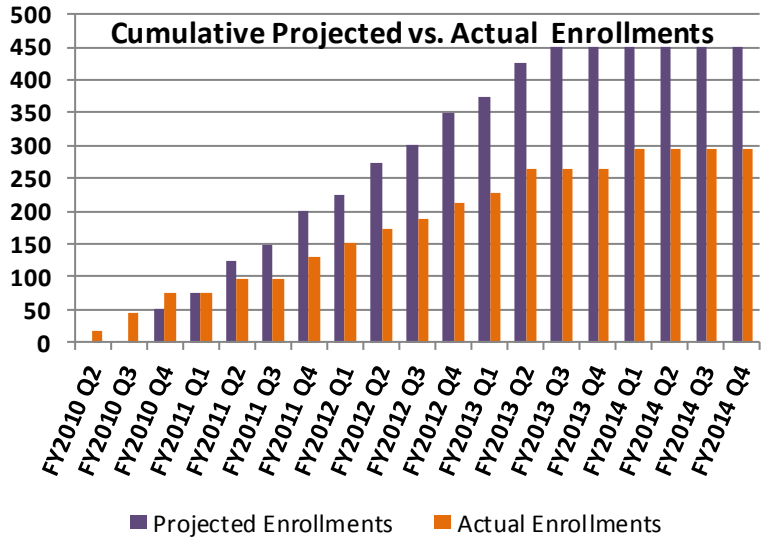
New York

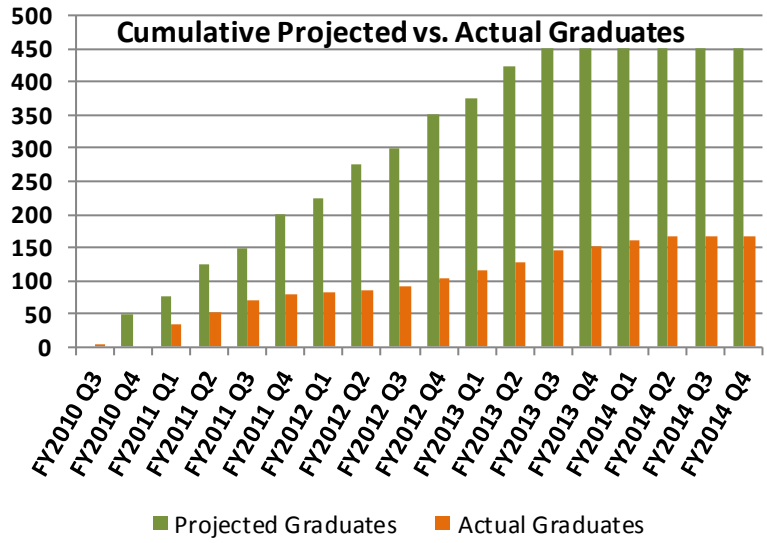
CID: OE0000491

Managed by the National Energy Technology Laboratory for the Office of Electricity Delivery and Energy Reliability

Metrics

Total Course Data	
Boot Camp / Apprenticeship Training	
Projected Number of Enrollments	450
Actual Number of Enrollments	296
Projected Number of Graduates	450
Actual Number of Graduates	166





The target number of 450 apprentices over the 4 year period of the grant was not met due to the current overall economic conditions and the attrition rate of new apprentices.