# *Colorado Online Energy Training Consortium*

## *An Interim Report*

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Rutgers' School of Management and Labor Relations (SMLR) is the leading source of expertise on the world of work, building effective and sustainable organizations, and the changing employment relationship. The school is comprised of two departments—one focused on all aspects of strategic human resource management and the other dedicated to the social science specialties related to labor studies and employment relations. In addition, SMLR provides many continuing education and certificate programs taught by world-class researchers and expert practitioners.

SMLR was originally established by an act of the New Jersey legislature in 1947 as the Institute of Management and Labor Relations (IMLR). Like its counterparts that were created in the other large industrial states at the same time, the Institute was chartered to promote new forms of labor-management cooperation following the industrial unrest at the end of World War II. It officially became a school at the flagship campus of the State University of New Jersey in New Brunswick/Piscataway in 1994. For more information, visit smlr.rutgers.edu.

## ABOUT THE EDUCATION AND EMPLOYMENT RESEARCH CENTER

Rutgers' Education and Employment Research Center (EERC) is housed within the School of Management and Labor Relations. EERC conducts research and evaluations on education and workforce development programs and policies. EERC research expertise includes community colleges, state and federal workforce developmental systems, skills development, college completion, and innovative and technology-based programs.

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## INTRODUCTION

The Colorado Online Energy Training Consortium (COETC),[1] a United States Department of Labor (USDOL) Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant-funded project has two primary goals. The first is to enhance energy-related programming in the state through the transformation of curricula into more accessible formats using technology and mobile learning labs. The second is a complete redesign of the developmental education pathway in the state. Colorado received this $17.3 million grant in 2011. The project is currently in its third year and recently received a no-cost extension from the USDOL for a fourth year (until September 30, 2015).

The colleges in the COETC consortium include all the community colleges in the Colorado Community College System (CCCS): Arapahoe Community College (ACC), Colorado Northwestern Community College (CNCC), Community College of Aurora (CCA), Community College of Denver (CCD), Front Range Community College (FRCC), Lamar Community College (LCC), Morgan Community College (MCC), Northeastern Junior College (NJC), Otero Junior College (OJC), Pikes Peak Community College (PPCC), Pueblo Community College (PCC), Red Rocks Community College (RRCC), and Trinidad State Junior College (TSJC). Two local district colleges, Aims Community College (Aims) and Colorado Mountain College (CMC) are also participating.

This interim report focuses on the development and implementation of redesigned energy programs under the COETC grant and outcomes to date. As such, the report will only look at activities as the seven participating "energy" colleges: Aims, CMC, FRCC, NJC, PCC, RRCC, and TSJC. (See Appendix A for a full list of acronyms.)

COETC energy colleges have used grant funds to develop and redesign educationally specific courses and program offerings for a variety of energy industries, including clean energy (solar, wind, and water) and process technologies in oil and gas. Redesigns seek to create "flexible" and "mobile" delivery options for certificate and/or associate's degree programs. These include a) transforming course delivery to be either completely online or "hybrid," a mix of online, classroom, and coursework, and b) the construction of mobile learning labs (MLLs), laboratory-equipped vehicles that can travel to remote locations. MLLs and migrating coursework to online formats enable students to pursue some or all of a certificate program and/or progress with courses toward a degree, without having to attend physically at a brick and mortar campus. These delivery strategies also allow greater schedule flexibility for students who are balancing work, family, and their studies than for those in traditional in-person classes.

The Rutgers School of Management and Labor Relations (SMLR) Education and Employment Research Center (EERC) serves as the third-party evaluator for this grant. Since the start of the grant, EERC has used both qualitative and quantitative methods to a) track program

[1] See Appendix A for a glossary of all abbreviations used in this report.

development and implementation, b) identify achievements and challenges, and c) collect and analyze outcome data.

## SUMMARY OF FINDINGS

The COETC is entering its fourth year under a no-cost extension from the United States Department of Labor (USDOL). A great deal has been accomplished by the energy colleges within the consortium, and much has been learned from the individual projects and across the projects. These findings are highlighted below.

### Community Colleges and Industry

- Employer engagement is essential to the development and maintenance of program curricula that adapt to shifting workforce realities and remain relevant to employers. Throughout the COETC grant period, industry partners have played an important role in working with colleges to a) identify important learning outcomes, b) design and develop curricula, and c) identify the state-of-the-art equipment and physical space necessary to train students to industry standards.

- College and industry partnerships are often more fruitful when industry employers send operations rather than human resource personnel to community college and sector meetings. While human resource specialists can provide valuable insights about industry requirements and the process of employment, operations personnel are better suited to inform curriculum development in terms of the knowledge and skill sets on which the college needs to focus.

- Employing industry personnel to teach CTE courses can create a stronger alignment between the field and the college, such instructors bring coursework to life teaching students about day-to-day challenges and solutions on the shop floor. These real-world lessons provide students with additional knowledge and skills and enhance competitiveness in the job market.

- Employers' feedback is essential to keeping CTE programming up to date. In the COETC grant, employer feedback on existing programs has stimulated the rethinking of course content and pedagogy and resulted in colleges' adding content to some traditional courses, redesigning them, or creating entirely new courses that will better serve industry needs.

- The addition of soft skills content was very high on the list of the colleges' energy industry partners. As a result, soft skills content has been integrated into both existing and new courses at many COETC colleges.

- Colleges and industry should be aware that they live in vastly different worlds and cultures. Colleges emphasize traditional students, classes, certificates, and programs; employers are more concerned about non-traditional students and the specific skill sets needed by an industry. The sense of time is also very different in their respective worlds. Companies need immediate action to keep production lines moving and meet consumer demand. In contrast, colleges think in terms of the academic calendar – and it may take one or more semesters to develop a new course with industry-specified content and have it approved by the colleges' and CCCS's academic standards review process.

- Project teams worry at times that they are not adequately preparing students with the relevant skills and/or knowledge. This is because communication between industry and the academy is not always effective. Each assumes that the other understands, when in fact, the different cultural worlds, as well as their use of language, has led to misinterpretations on both sides. Best intentions are insufficient if they are not combined with clarity and checking in for immediate feedback to ensure that the message sent is the message heard. The focus of all redesigns and new programming has been the creation and enhancement of certificates and degrees that better respond to the needs of the energy industry and are delivered in the most effective manner to prepare students for the workforce.

**Flexible and Mobile CTE Design and Delivery**

- The transformation of course delivery to online and hybrid formats requires faculty buy-in. In the COETC grant, faculty members raised concerns about what could be taught online and/or in hybrid formats while maintaining the same quality of teaching and learning as in-person instruction. They also worried that industry would not recognize online and/or hybrid formats as equal to the tradition of hands-on learning. These questions and important issues must be dealt with prior to developing online or hybrid CTE coursework.

- Instructional designers were essential to the creation of online and hybrid coursework. Hiring instructional designers was a challenge for some colleges in the COETC grant. In the end, the hiring of a centrally located instructional designer was an innovative and effective staffing strategy for achieving grant goals for both the colleges and CCCS.

- Despite the growing use of online and hybrid courses by the energy programs, two significant barriers have emerged to their use. The first is the availability of and access to high-speed Internet and computers for students, especially in rural areas where Internet services are inconsistent or appropriate infrastructure is absent. The second is that energy programs often require specific physical capacities and hands-on skill – this can make creating fully online programming challenging or impossible. Mobile learning labs (MLL) can make the ability to deliver online and hybrid trainings in the energy sector more feasible.

- MLLs can be very successful marketing and recruitment tools for colleges.

- Collaborating with industry on MLL programming is a good way to increase the capacity of MLLs to serve multiple programs and multiple locations.

- Maintaining a mobile learning lab is costly and can be logistically challenging. These are important factors for both the use and sustainability of MLLs.

**Community Colleges and the Workforce System**

- For COETC colleges, working with workforce centers has been an exercise in building and sustaining relationships both institutionally and individually. Without a strong relationship between key staff members at each institution, significant challenges emerge in coordinating the various services and opportunities that are available to job seekers.

**Credentials Earned**

- Over the course of the grant – spring 2012 to summer 2014 – 901 credentials have been earned at energy colleges in the COETC grant: 86 associate's degrees, 349 credit-bearing certificates, and 466 non-credit-bearing certificates.

- 288 unique students earned a credit-bearing certificate or degree – many students earned more than one certificate: 242 earned certificate awards and 86 earned AAS degrees.

- The majority of credentials were earned by non-traditional students, those age 25 years and older. Almost three-quarters (72 percent) of all award and degree recipients were non-traditional students.

- In the COETC program, the stacking of credentials, degrees, and certificates has been common.

**Career Coach**

- The rate of completion of a degree across all energy colleges and students enrolled in at least one redesigned energy course were significantly higher if the student had at least one contact with the career coach.

## METHODOLOGY

### Quantitative Methodology

Data were collected from CCCS on behalf on the system schools (FRCC, NJC, PCC, RRCC, and TSJC) and directly from Aims Community College and CMC under data-sharing agreements established with the system and the two non-system schools. Data were collected at the end of each (federal) fiscal year during the first two years of the grant. Because of a change in the reporting tool of the ODS database system maintained at CCCS, all data for the reporting period were collected during August 2014 to ensure consistency with prior report queries. Data for unique student participants were queried from the course listings of redesigned courses as maintained by CCCS at cccscoetc.weebly.com and validated by the partner colleges. Unemployment wage data for student participants were matched to student numbers based upon the USDOL quarterly reported wages through Q4-2013.

Upon receipt of the data, EERC transformed and recoded variables to measure student economic and academic outcomes. Data from the non-system schools were also transformed to match the system variable labels and values. The variables utilized in the data analysis are described in Appendix B.

### Qualitative Methodology

Attention to the process of developing and implementing redesigned energy courses and programs is important to identify a) promising/best practices, b) unique and systemic challenges, and c) the possibilities for scaling and replication. To that end, EERC has conducted phone and in-person interviews with project leads, energy faculty, instructional designers, data coordinators, senior college administrators, and, when possible, students. EERC team members have been participant-observers on COETC project conference calls, webinars, and in-person meetings with project leads and career coaches. In addition, project lead and career coach surveys have been administered. When possible, interviews have been taped and transcribed. These and the aforementioned documents and surveys have been analyzed using the Nvivo software to identify themes and patterns. Further, the qualitative team has worked closely with the quantitative team to triangulate the data analysis.

## CONTEXT

### Market Background

In the past decade, Colorado's energy sector as a whole has experienced significant expansion, including a 56 percent increase in industry-specific direct employment to 122,400 jobs in 2012.[2] In the same year, annual salaries across the sector were $80,891, well above Colorado's median

[2] BCS Incorporated. (Nov. 2013). Colorado's Energy Industry: Strategic Development through Collaboration. Accessible at www.colorado.gov

household income of $57,685 per year.[3] In 2012, the combined energy industry in Colorado brought in over $24 billion in revenue.[4]

The diversity of Colorado's energy sector has resulted in industry-specific and cross-industry integration/networks that affect state and regional economies. The mining industry accounts for $7 billion of Colorado's annual GDP and 57,000 direct and indirect jobs.[5] Nationwide, the oil and gas industry experienced a 40 percent increase in jobs during the recession of 2007-2012.[6] In Colorado, the industry directly and indirectly employs 110,000 people and contributes 11 percent of Colorado's GDP – $29.6 billion.[7]

The above data reflect the importance of the energy sector in Colorado – in fact, it is considered the third most important sector in Colorado after information technology and financial services.[8] It is also one that the state government has promoted through both statute and executive orders. However, it has been significantly affected by shifting demand and state and federal legislative action or inaction.

In 2004, Colorado became the first state to enact a renewable portfolio standard (RPS) through a voter ballot initiative. This standard requires that investor-owned, electric cooperatives and municipal utilities use renewable sources of energy in their generation of electric power. The RPS has been expanded over the years to increase the percentage of power generated by renewable sources such as wind and solar. As a result, there has been an expansion in these industries.[9]

Given increased demand and an ongoing potential for drought conditions, the water industry has also been a focus in the state. In 2013, the governor signed an executive order calling for the development and implementation of a state water plan.[10] Despite over 90 separate incentives for energy efficiency and the use of renewable energy promulgated by Colorado's state and local entities,[11] federal inaction on the Renewable Energy Production Tax Credit (PTC) caused a substantial contraction in Colorado's wind industry. According to the American Wind Energy Association (AWEA), just the anticipation of the December 2013 expiration of the 2.3 percent tax credit[12] led to a national decrease of over 76 percent in wind installation production. In Colorado, new wind installations dropped from 496 to 31 megawatts (MW) in the months prior

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[3] BCS Incorporated. (Nov. 2013). Colorado's Energy Industry: Strategic Development through Collaboration. Accessible at www.colorado.gov

[4] Ibid

[5] Colorado Mining Association. (Apr. 2014). Mining Brochure. Accessible at www.coloradomining.org

[6] Colorado Oil & Gas Association. Economics 101: Colorado's Oil & Gas Industry... Accessible at www.coga.org

[7] Ibid

[8] Colorado Energy Coalition. (Dec 2013). Resource Rich Colorado: Colorado's National and Global Position in the Energy Economy. Accessible at www.metrodenver.org

[9] SB 13-252 (Jun 2013). Accessible at www.colorado.gov

[10] Executive Order D 2013-005

[11] U.S. Department of Energy. Tax Credits, Rebates & Savings. Accessible at www.energy.gov/savings

[12] American Wind Energy Association. Federal Production Tax Credit for Wind Energy. Accessible at http://www.awea.org/Advocacy

to the December sunset of the tax credit. Estimates for 2014 suggest that there will be a slight rebound to 60 MW, but this is far below the levels achieved when the tax credit was in place.[13]

The sunset of the Renewable Energy Production Tax Credit (PTC) had a direct effect on FRCC's COETC program offerings. The original FRCC proposal included plans for three certificate programs (wind, solar, and a smart grid), but with the elimination of the tax credit resulting in a significant decline in employment opportunities, FRCC decided to eliminate the wind and solar certificate programs. Instead, the college chose to focus its efforts on creating coursework and certificates in general manufacturing.

Despite the sunset of the PTC, the future of Colorado's energy sector generally looks positive. At the same time, it is important to note that the COETC grant was launched just as the nation was emerging from the Great Recession. Using North American Industry Classification System (NAICS) codes related to the energy sector,[14] EERC found that employment trends in the energy sector were similar to those for all jobs in Colorado (Figure 1).[15] Both patterns of employment reflect the Great Recession. However, of significance is that the large dip in energy sector employment in the second and third quarters of 2011 is due almost entirely to a change in the number of people reported to be employed under the NAICS code "Electric Power Generation, Transmission and Distribution."[16]

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[13] American wind Energy Association. (Apr. 2014). State Wind Energy Statistics: Colorado. Accessible at www.awea.org

[14] NAICS codes used for the analysis: 2111 Oil & Gas Extraction; 2121 Coal Mining; 2122 Metal Ore Mining; 2123 Nonmetallic Mineral Mining and Quarrying; 2211 Electric Power Generation, Transmission and Distribution; 2212 Natural Gas Distribution; 2213 Water, Sewage and Other Systems; 2371 Utility System Construction, 3241 Petroleum and Coal Products Manufacturing, 4861 Pipeline Transportation of Crude Oil, 4862 Pipeline Transportation of Natural Gas, 4869 Other Pipeline Transportation, 5621 Waste Collection, 5622 Waste Treatment and Disposal, 5629 Remediation and Other Waste Management Services.

[15] Note: the two plots use different scales for the y-axis, employment. Left: Colorado's employment varies from just above 2 million workers to nearly 2.3 million. Right: employment in the energy sector varies between 43,000 and 51,000.

[16] Code 2211

**State Employment Data**

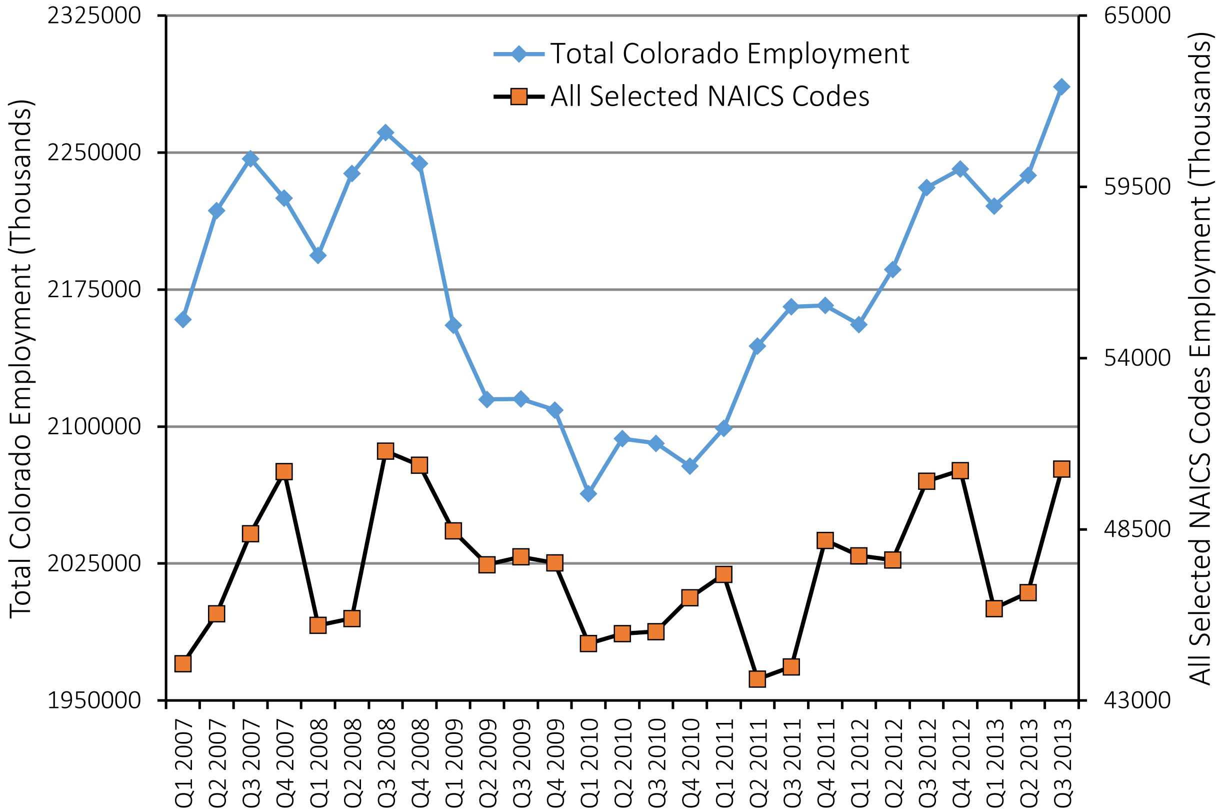


**Figure 1. Trend Analysis of Colorado's Total Employment for All Sectors and Selected NAICS Energy Industry Codes**[17]

Source: U.S. Census Bureau

Industry-specific trends can further be observed in Figure 2, which compares general employment with employment in the natural gas industry.[18] The natural gas industry has experienced generally steady growth without any real losses during the recession. This reflects the large expansion of natural gas extraction, including the hydro-fracking that is taking place in Colorado. The data shown here were echoed in the conversations between EERC team members and project staff and faculty during site visits and suggest opportunities for increased recruitment and enrollment in the programs offered by Aims and CMC.

[17] NAICS codes were then grouped into sectors related to the energy schools' programs. With the following code groups, there was no substantial difference between the group employment and Colorado employment: Water Quality Management (2213, 2371, 5621, 5622, and 5629), Mining (2121, 2122, and 2123), and Energy Production (2111, 2211, 2212, 2371, 4861, 4862, 4869)

[18] Note again that the two y-axes are on different scales, so the chart only indicates trends.

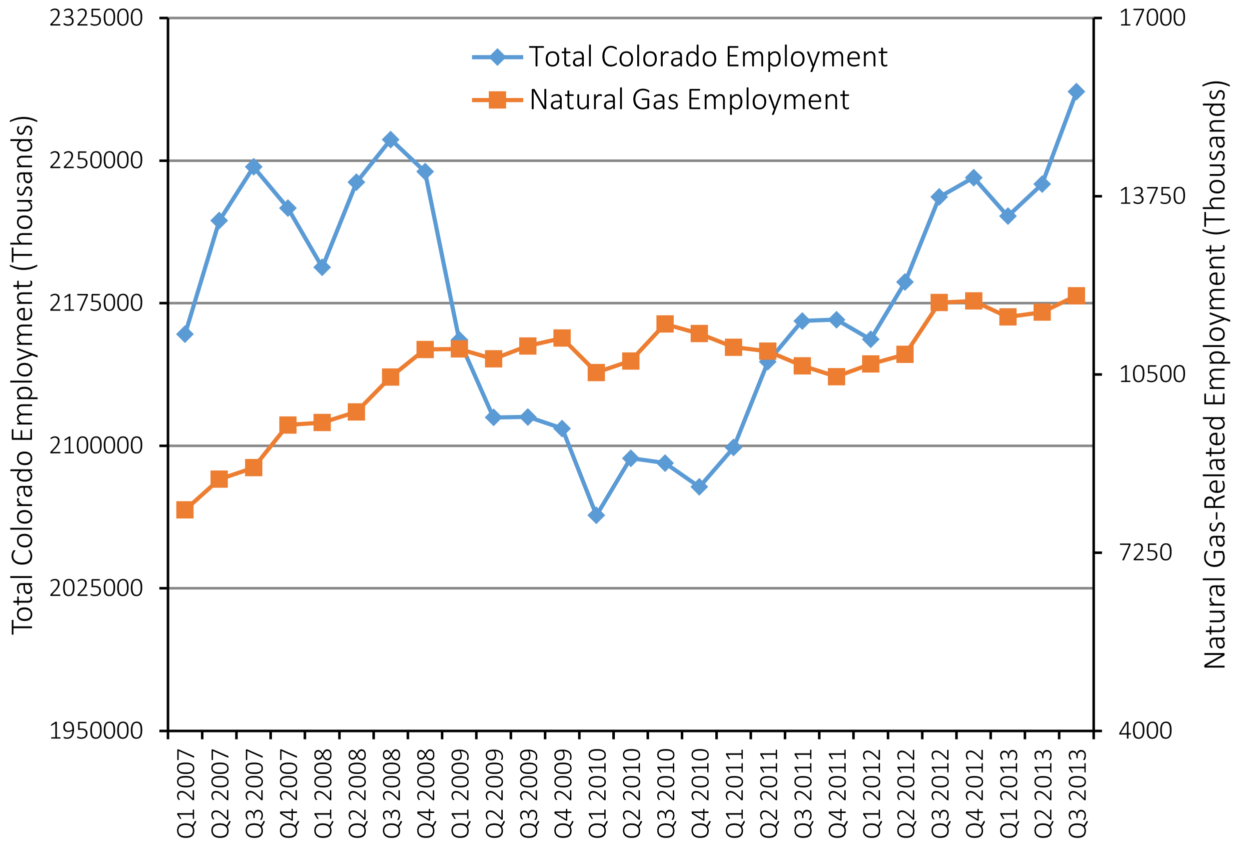


**Figure 2. Total Colorado Employment and Natural Gas-Related Employment – Q1-2007 through Q3-2013**

## COLLEGE–INDUSTRY PARTNERSHIP

Over the last decade, sector strategies have emerged as a promising model for economic development, inspiring experimentation, research, and scholarship. Colorado is one of many states to embrace sector partnerships as a model for workforce and economic development. Colorado's adoption of sector strategies reflects its recognition that new approaches are needed to ensure that the state has a skilled workforce to meet the needs of local businesses and to maintain the state's economic competitiveness.[19] College-industry partnerships enable colleges and employers to "leverage their combined knowledge of labor markets, skills, pedagogy, and students."[20] The exchange of information can foster the development of certificate and degree programs that in turn can provide individuals with the skill sets and knowledge that industry

[19] Colorado SECTRS Initiative: Solicitation for Grant Applications. Accessible at http://www.coworkforce.com/pgl/pgl/pgl0811wiasectrsinitiativesgaexecutivesummary.pdf

[20] Soares, Louis. 2010. The Power of the Education-Industry Partnership. Fostering Innovation in Collaboration between Community Colleges and Businesses. Washington, DC: Center for American Progress, p.1.

requires, in addition to opportunities for incumbent workers to expand their skills and earn additional credentials.[21] Both of these may result in job promotions and/or increased wages.

> Global competition contributes to increased pressure on business and industry to be more productive. The demand for skilled labor grows. As a result, the training needs of employers have expanded and accelerated. Communities that prosper are ever more dependent on employers that respond to the need for skilled labor.[22]

Historically, community colleges have an advantage over four-year institutions in establishing industry partnerships. They often are located in the same communities, which facilitates mutual accessibility,[23] and frequently, their respective employees enjoy overlapping professional and social networks. Further, of critical importance, community colleges often have greater flexibility in how they structure their course offerings, including continuing education.

The literature also suggests that effective and sustainable partnership between educational institutions and industry is as critical to students' retention and successful completion as to their employability prospects.[24]

Although not a part of any sector initiative project, it was in the context of increasing attention to sector initiatives that Colorado's Community College System (CCCS) developed its TAA-COETC grant proposal. The proposal recognized a changing labor market – the transfer of jobs overseas, changing technology, and projected labor shortages caused by the graying of workers and responded to these challenges by creating new opportunities to retool displaced workers and train a new generation of workers for jobs in the energy industry, especially renewable energy, an industry with ongoing potential for growth.

From the start – even as the Trade Adjustment Act application was being developed – colleges in the COETC consortium reached out to regional industries. They asked them to define which certificate and degree programs were needed and which existing ones needed to be enhanced. Feedback from energy companies was therefore instrumental in helping colleges identify as well as shape the certificate and degree programs that would become the focus of their grant activities. The final list of energy industries and credentials developed and redesigned under the COETC can be viewed in Table 1.

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[21] MacAllum, Keith, Karla Yoder, and Anne Rogers Poliakoff. 2004. The 21st-Century Community College: A Strategic Guide to Maximizing Labor Market Responsiveness. Washington, D.C.: Prepared for the U.S. Department of Education by the Academy of Educational Development and Westat, p.1.
[22] Ibid
[23] See here: http://files.eric.ed.gov/fulltext/ED472019.pdf (p.78)
[24] See, for example, http://www.nxtbook.com/ygsreprints/ACTE/g29846_acte_techniques_novdec2012/#/20

**Table 1. Colleges, Industry, and Credentials**

| College | Industry | Credential |
|---|---|---|
| AIMS | Oil and gas | AAS, Certificates |
| CMC | Process technology, instrumentation in solar and oil and gas | AAS, Certificates |
| FRCC | Electro-mechanical and energy technology | AAS, Certificates |
| NJC | Wind energy | AAS |
| PCC | Mining and extractive technologies | Non-credit Certificates |
| RRCC | Water quality management technology | AAS, Certificates |
| TSJC | Line technician | AAS, Certificates |

In addition to helping shape program foci, industry employers helped college faculty identify state of the art equipment and the necessary physical space that would allow students to be trained to industry standards.

A U.S. Department of Education, Office of Vocational and Adult Education report has described employer engagement at the curricular level "as a continuum of involvement that ranges from serving on advisory boards for technical degree programs to actively participating in the development of curriculum and training."[25] The highest level of employer engagement contributes to the close integration of employer needs and community college training programs. This includes not only the development of program curricula but their ongoing adaptation to shifting workforce realities to ensure that they remain relevant to employers.[26] Under the COETC grant, colleges have actively worked to keep abreast of industry changes and to revise content accordingly.

**Advisory Committees/Boards**

In Colorado, local schools and institutions that offer career and technology programs and receive state and federal funds are required by the Career and Technical Act to establish program advisory committees. Members of these committees "assist educators in establishing, operating, and evaluating programs…" and "provide expertise pertaining to technological

[25] U.S. Department of Education, Office of Vocational and Adult Education, Integrating Industry-Driven Competencies in Education and Training Through Employer Engagement, Washington, D.C., 2011, p.11. http://www2.ed.gov/about/offices/list/ovae/pi/cclo/brief-4-employer-engagement.pdf

[26] Ibid

change."[27, 28] Advisory committee members may be asked to help with curriculum reviews and the development of new content, as well as help to identify specific competencies and mechanisms to assess students' ability to meet industry standards. In addition, advisory committees may help a program establish internships and serve as a resource exchange for employment opportunities. Colleges that offer an array of career and technical education (CTE) programs may establish multiple advisory committees to address the issues and needs of specific subject areas. For example, Aims Community College has an industrial technology committee separate from its oil and gas technology committee. Similarly, Pueblo Community College has created several advisory boards, including a board for welding technology and a board for machining.[29]

The composition of advisory committees varies by industry and college but usually includes faculty, industry representatives/employers, representatives of local workforce centers, and representatives of professional organizations. Large and small local service companies frequently send human resource personnel. While human resource specialists can provide valuable insights about industry requirements and the process of employment, industry representatives from the operations side are better suited to inform curriculum development and the skills on which the college should focus. Colleges have thus encouraged companies to send more technical decision-makers and subject matter experts to committee meetings. One member of the FRCC faculty spoke about his efforts to change the kind of representation sent by industry to program advisory committee meetings:

> So we're working on establishing more relationships with the operations people. And it's happening because I got a note back from the Anheuser-Busch people. They're going to send over their senior operations manager and maintenance manager. The same as Wolff Robotics – they sent people who were operations. So we're trying to move kind of away from that (human resources) and get the operations folks because I think they're the ones who deal with people day by day – know what they want.

Similarly, CMC's career coach noted:

> …at the end of the day, you're always working with HR in the big picture. There's always an HR department, even for the smallest energy company. But the hiring decisions in energy are made at the mid-management level by program managers, operations managers, individuals with those kinds of titles … at companies like Enterprise or Chevron or Bill Barrett, as an example. And what happens… is that I build a relationship with one of those operations managers.

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[27] See: Guide to the Operation of Career and Technical Education Advisory Committees http://www.coloradostateplan.com/CTE/AdvisoryCommitteeHandbook7-08.pdf, p.ii

[28] See: http://www.coloradostateplan.com/CTE/AdvisoryCommitteeHandbook7-08.pdf, p.1

[29] See: http://www.pueblocc.edu/CTE-Minutes/

The Career and Technical Act requires that advisory committees meet at least twice per year. Colleges hold meetings to exchange information and discuss curriculum issues, the assessment of student competencies, and changes in industry standards, equipment, and/or production processes.
Through its advisory committees and through the outreach activities of the COETC career coach and faculty, Aims has established active working relationships with the major and minor local oil and gas employers in their service area. This has increased the potential of Aims graduates to be employed by regional companies. As a member of the Aims faculty observed:

> We built that [program] with industry input. And so they are recognizing it. Most [of] our partners have said [that] if we see that [the energy certificate or degree] on somebody's resume, we'll give them an interview. So it's really built around what they [the industry experts] want us to do.

The alignment between the field and the college has also been strengthened at colleges through their employment of industry personnel to teach courses. Thus, for example, the line technician instructors for TSJC's Trinidad and Colorado Springs program are seasoned, experienced line technicians. At RRCC, many of the water quality management technology instructors are full-time water utility employees. Students shared with the EERC team how much they appreciated having instructors from the field. These instructors bring coursework to life and have been essential in their learning day-to-day field mechanics and the skills needed to be competitive in the job market. Project leadership, however, noted that part-time instructors are not always able to meet curriculum deadlines and complete redesign work as anticipated.

Career coaches, whose role will be described in more detail below, have also played a critical role in establishing and maintaining contacts with employers and workforce centers (WFCs).[30] Coach activities in this regard have included organizing individual meetings and job fairs, arranging mock interviews, and negotiating internship opportunities and students' job placement.

**Responding to Industry Needs**

In addition to the more formal advisory boards, COETC energy colleges utilized a variety of strategies to engage with and learn from industries,[31] as well as to market their programs. For example, the career coach at FRCC contacted local employers to research changing local and regional needs:

> So we wanted to make sure that the certificate program would meet the needs of the business community. I went out and interviewed 33 companies in our service region:

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[30] Recently, Work Force Centers have changed their name to American Job Centers. However, to maintain consistency with other EERC reports, we will continue to use their former name.
[31] See, for example, Burd, Suzanne, Renewable Energy Industry Needs Assessment Report, December 2009. Accessible at http://www.yakimacounty.us/wdc/docs/EnergyNeedsAssessment.pdf.

> different types of companies, small job shops, and large corporations. Tried to understand how critical the need was for machinists and what kind of skills they were looking for.

The FRCC project team learned that regional wind and solar employers were laying off rather than hiring workers and discovered the existence of short-term CTE certificates being offered by other colleges. As noted above, these conversations caused FRCC to shift its focus from solar and wind to the redesign of its general manufacturing certificate and degree programs.

Employers' feedback about existing programs has stimulated the rethinking of course content and pedagogy and resulted in colleges' adding content to some traditional courses, redesigning them, or creating entirely new courses that would better serve industry needs. For example, employers across the energy sector recommended that the colleges add "soft skills" to the curriculum, including communication, professionalism, critical thinking and problem solving, teamwork and leadership. The CMC project team described the following experience:

> I'm already hearing from folks that you need to incorporate some more of that. You need to incorporate some more of that time management and communication and the whole teamwork piece into your classes, and I think that that's going to be an indirect benefit of this TAA is that we're going to have a stronger program.

As a result of these discussions, over the past three years, soft skills content has been integrated into both existing courses and new courses. At a number of colleges, to complement the program's set of required courses, the career coach was assigned to lead workshops on these issues, e.g., RRCC's Bring Your-A-Game to Work.

Finally, many employers want their incumbent workers to get more training but cannot provide either release time and/or tuition fees. To respond to the need for incumbent training, PCC built on some of its work under the Colorado State Department of Labor and Employment sectors project and reached out to some of the oil and gas companies in southwestern Colorado. They provided noncredit training courses to these companies, often tailored to a specific skill set. Further, through the use of their mobile learning labs – some constructed under sectors and some under the TAA-COETC grant, PCC provided incumbent training across their service area.

To market their availability to help regional companies, PCC has been e-mailing them a newsletter "just [to] give them ideas of some of the kinds of training that we offer." The newsletter showcases PCC's energy-related programs and describes opportunities for incumbent worker training through the use of mobile learning labs and online resources. As the project lead observed, "'a lot of people don't realize that ... what a resource we really are, and so ... you know, it's an educational process to them." This exchange of resource information is yet another means of strengthening the partnerships between colleges and industry and meeting some of the less visible needs that frequently remain on the company floor.

**Challenges**

Colleges and industry, however, live in vastly different worlds and cultures. Colleges emphasize traditional students, classes, certificates, and programs; employers are more concerned about non-traditional students and specific skill sets needed by an industry. The sense of time is also very different in their respective worlds. A company needs immediate action to keep the production line moving and meet consumer demands. In contrast, colleges think in terms of the academic calendar, where it may take one or more semesters to develop a new course with new industry-specified content and have it approved through the college's and CCCS's academic curriculum review process.

As an interviewee observed about the two worlds, "there is correlation but not necessarily an exact match." This has led at times to some frustration on both sides. While colleges want to be responsive, given limits on faculty time and the academic cycle, they cannot always meet industry's expected timetable for the redesign of a curriculum and/or the launch of a new course requested by industry.

In addition, despite best intentions, project teams at times wonder if they are adequately preparing students with needed and relevant skills and/or knowledge. For example, faculty are not always clear about industry hiring requirements and/or practices. This may be the result of rapid changes at an employer worksite and/or miscommunication between industry and colleges. To improve communication, there needs to be more specificity by industry concerning the skills and experience they need for a particular position. Industry also needs to provide expertise and actively help the colleges develop the courses and programs to meet their needs. On the other hand, the colleges need to be clear about current program capacities as well as realistic timelines to change curricula and program offerings. In addition, when new equipment is needed, colleges must be explicit about the challenges they face – resources to pay for purchase and maintenance, as well as the often long delays between ordering, faculty training, and use by students.

COETC colleges also expressed concern about balancing the needs of both large and small firms. More often than not, the main players at the table are from larger firms. Smaller companies are less well known, not invited, and/or cannot participate because of their staffing limitations.

> And the other thing I would say to that, though, is I think one thing that we're seeing ... is that we're getting more industry. I think we've always had a good relationship with Encana and Williams, but when we got up to Enterprise, they had no real idea what we were doing…. Yeah, well, Enterprise isn't new. Enterprise has been here since 2004. It's just [that] no one's ever reached out to them, and I think we are in a position now where we are starting to see stuff like Bayou Well Services. They've been around for four or five years, and they're just now starting to get on board with this. And so I think we did

> have a good goal, but I think it was all focused on two main players … and I think [that] the more people we get, we're going to start to see more of the smaller players.

As will be discussed in the next section, college–industry collaborations have resulted in many real achievements; however, going forward, it will be important to address some of the above concerns. This will require the conscious recognition of college and industry differences simultaneous to the affirmation of their common goal – to train a workforce to meet industry needs. It will also require that advisory committees continue to receive college and industry support as a mechanism to work out solutions and bridge their two cultures.

In this regard, it may be helpful for CCCS to explore the possibility of some post-grant mechanisms and resources to facilitate college–industry partnerships, as well as to explore opportunities for the energy colleges to become involved in sector initiatives across the state.

## COURSE AND PROGRAM REDESIGNS

### Industry Collaboration in Curriculum and Program Development

The focus at all of the colleges has been to create and improve certificates and degrees that respond to industry needs and effectively prepare students for the workforce. In most cases, the development of new degrees and certificates, as well as the redesign of existing curriculum, has involved some level of consultation or collaboration with industry. Faculty and staff at many of the colleges spoke about the importance of these collaborations. For example, representatives from Aims worked closely with the major and minor local employers in the oil and gas industry. The employers have played an ongoing role in reviewing the curriculum, identifying missing course content, and discussing effective ways to develop students' skill sets. These collaborations have resulted in raising the profile of the program and have already fostered an increase in post-training employment.

FRCC has also worked hard throughout the grant to meet actual and future regional workforce needs. As noted above, after deciding not to focus on wind and solar, faculty and staff worked to reshape their direction and goals to better fit changing local and regional needs. Doing this involved both conversation and research with companies throughout the region and analysis of that data.

Many colleges, including TSJC, CMC, PCC, and RRCC, had professionals from their target industry working in their programs and helping to shape and develop curriculum to respond to industry needs.

**Contextualized Developmental Education**

In addition to its focus on energy, the COETC grant also involved a complete redesign of the developmental education pathway in the state of Colorado. For the most part, these two portions of the grant occurred in isolation, but there was one unique piece of the grant that brought these two goals together: contextualization of developmental education for energy. For example, Aims built a Math for the Trades class especially for energy program students who tested into developmental math, while TSJC and RRCC developed online math tutorials to help energy students improve their math skills.

FRCC and CMC developed coursework in all three of the developmental education areas: math, English, and reading. The math programming was primarily a refresher to help students with the skills needed for their energy coursework. The English and reading classes focused on the writing and reading comprehension skills that students would need in energy jobs. It was hoped that the contextualization of developmental education coursework at all of the colleges would improve retention and completion time for energy students.

**Hybrid and Online Courses**

One the goals of the COETC grant was to create "flexible" and "mobile" delivery options for certificate and/or associate's degree programs in the energy sector. Such flexibility would increase program access to students living at a distance from a college campus, as well as students balancing work and family responsibilities with their studies. In addition, colleges wanted to better serve the needs of workers already in the energy field who wanted to upgrade their skills or earn new credentials.

The key strategy to achieve flexibility has been the transformation of course delivery – completely online or "hybrid," a mix of online and in-person classes. This was a huge undertaking. The first step was to gain faculty buy-in to the idea. Faculty raised concerns that the formats might not maintain the same quality of teaching and learning that they desired and that industry would not recognize online and/or hybrid formats as equal to the tradition of hands-on learning. Facing increasing competition from proprietary wind industry programs, NJC faculty worried that online formats would place them at a disadvantage. Other faculty observed that it might be possible to develop introductory courses in online or hybrid formats, but why would someone begin an online wind course of study before he/she was clear that he/she was able to climb 300 feet to the top of a wind turbine? To establish that capacity, the potential student needed to be on campus and successfully climb the "mock" tower. Similarly, TSJC faculty teaching the line tech programs told the EERC team that one may not be aware of a fear of heights before actually climbing a 50-foot pole.

**Figure 3. TSJC's Colorado Springs Line Tech Certificate Training Yard**[32]

Many faculty had no prior experience with either online or hybrid formats, which alone caused some pushback, and often had little idea what content might be malleable for conversion to online or hybrid formats. A solar energy faculty member at CMC said that he researched online course delivery extensively before starting to redesign his course, "looking stuff up on YouTube, understanding that ... there is science and tech stuff there all over. You know, the National Science Foundation..."

While it was certainly important for faculty to better understand online learning to conceptualize what was possible and how it could be done, colleges realized that additional expertise was needed. To that end, many colleges included an instructional designer in their project budgets. Both RRCC and CMC had success in hiring instructional designers to work with them. Other energy colleges, however, were challenged to recruit a designer with the right skill set or with whom they could negotiate a competitive salary and/or work schedule. More rural colleges were particularly challenged. This was the experience of Aims, which struggled to find a qualified instructional designer to fill a part-time appointment.

Midway through the COETC grant, CCCS hired a full-time instructional designer who was then enlisted to help the colleges with their online and hybrid coursework as well as program products for OER. The employment of a central office instructional designer who worked with individual colleges had an immediate impact. Within months of her arrival, most of the colleges were able to launch one or more online and hybrid courses. Hiring a centrally located instructional designer thus turned out to be an innovative and effective staffing strategy for achieving grant goals for both the colleges and CCCS.

[32] Photo by Suzanne Michael.

Each college has its own story. However, across colleges, instructional designers were instrumental in addressing faculty concerns and changing faculty perceptions about and reducing resistance to hybrid and online courses. Pushback was replaced by buy-in or, as reported by Aims, a “snowball[ling]” of support throughout the department with other faculty “join[ing] the ‘online’ bandwagon.” Similarly, at RRCC, the project lead reported that the college’s water quality management faculty now “embraced D2L (Desire2Learn) and hybrid delivery.”[33]

Faculty also began to speak of the benefits online and hybrid formats brought to the college and students. At Aims, the project lead reported that the college had moved from being unable to fill online and hybrid sections to having a wait list in some semesters. As a result, the college was considering adding more sections. Aims’s online programs have become “very popular” with incumbent workers, who are now able to take courses remotely. Online courses have also enabled the college to serve larger numbers of incumbent workers interested in improving their skills and/or stacking their credentials.

TSJC has found that, in its newly implemented fully hybrid line tech certificate, the online course content “supports face-to-face instruction [and] has positively affected student comprehension.” Staff from PCC have reported that new online coursework provides their students with an additional opportunity to develop computer literacy, an increasingly important skill in the job market. Finally, more rural colleges with large services areas, such as the 12,000 square miles of CMC, have found that online courses expanded the geographic reach of their energy programs.

Colleges also put programming online at the request of industry. Several months into the grant period, PCC asked for an amendment to their grant contract that would allow them to develop a hybrid commercial driver’s license (CDL) program to serve the needs of the energy industry in Southwestern Colorado. The request was supported by statements from a number of employers in the region who said that an online CDL course would be useful for them.

While only RRCC’s water quality management program has been completely transformed into an online/hybrid format, all the colleges now offer online and/or hybrid courses, as shown in Table 2. Sixty-six unique courses have been redesigned as hybrid or online options. Those categorized as both hybrid and online courses have been offered over time in each format. The column shaded in blue indicated the number of courses that utilize the lab within either an online or a hybrid course.

[33] Desire2Learn is an online teaching platform.

**Table 2. Number of Redesigned Hybrid or Online Courses by College**

| | Total Unique Program Courses | Hybrid | Online | Mobile Lab Utilized within a Hybrid/Online Course | Total Unique Program Courses Delivery Redesigned |
|---|---|---|---|---|---|
| **Aims*** | **21** | 2 | 10 | 0 | **12** |
| **CMC** | **20** | 20 | | 11 | **20** |
| **FRCC** | **17** | 6 | 2 | 0 | **8** |
| **NJC** | **17** | 1 | 1 | 0 | **2** |
| **PCC**** | **7** | 3 | | 0 | **3** |
| **RRCC** | **24** | 12 | 12 | 8 | **24** |
| **TSJC** | **20** | 7 | 5 | 0 | **9** |
| **TOTAL** | **119** | **49** | **20** | **15** | **66** |

*Classes marked as both online and hybrid in the Banner data were categorized as hybrid.
**PCC delivered multiple modules within courses.

Despite the growing use of online and hybrid courses by the energy programs, two significant barriers have emerged in terms of their use. One is the availability of and access to high-speed Internet and computers for students, especially in rural areas where Internet services are inconsistent or an appropriate infrastructure is absent. This is an ongoing concern and frustration for colleges with rural service areas. To begin to address the issue of access, PCC now offers open computer lab sessions on campus (providing temporal if not geographic flexibility for the students who lacked access at home) and has further collaborated with local libraries, workforce centers, and other organizations in its services area to expand students' access to public computers. However, for students who are truly remote, until needed infrastructure is built, the very programs developed for them will not be accessible. Further, programs such as line tech and wind energy that require specific physical capacities and hands-on skill, full conversion to online formats will not be possible.

**OER Publication**

The U.S. Department of Labor requires that the curricula and training materials developed with TAACCCT grant funds become open educational resources (OER).

OER refers to teaching, learning, and research materials that have been made available to the public, released from the restrictions of intellectual property licenses [Creative Commons

Attribution 3.0 license (CC BY)]. As public domain materials, they can be used freely as desired, including adaptation, adoption, and/or repurposing.

Some colleges, notably those schools with in-house instructional designers such as CMC and RRCC, were very successful in developing materials and publishing them online. In fact, RRCC's OER preparations were described as "smooth as silk."

Beginning in July 2013, the CCCS designer began to work with the other colleges to identify and format their materials for OER publication. As she responded to faculty fears about publishing materials, she facilitated the preparation and publishing of increasing numbers of course materials that had been developed under the COETC grant. In fact, during an interview with EERC, she observed that, once one college "showed no fear" in putting coursework online, others followed suit. The CCCS instructional designer has proven so helpful as a "coach" and resource for the colleges that she is now coordinating all grant-related OER-related activities.

COETC colleges use the Weebly hosting platform for all OER grant materials.[34,35] The site serves multiple purposes: it provides a platform for COETC schools to showcase redesigned curricula, provides the colleges with easy access to the work done by their consortium partners, and fulfills the federal requirement to make grant-funded materials publicly available.

The Weebly site organizes project materials by energy field and college and now contains a range of materials, including full courses, course materials, modules, videos, syllabi, problem sets, practice worksheets, and information sheets on various topics, among other things.

## MOBILE LEARNING LABS

### Expanded Services

As part of their efforts to extend the geographic reach and the populations served, a number of the energy schools constructed mobile learning labs (MLLs). MLLs are vans or truck trailers containing lab equipment that faculty can use to conduct classes off campus. Originally, five colleges proposed MLLs for the grant, but only CMC, RRCC, and PCC ended up constructing MLLs. With the aforementioned changes in program foci, Aims and FRCC requested and received authorization to use the funds initially allocated for MLLs to improve their on-campus lab facilities.

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[34] Weebly was chosen at the platform because the instructional designer was familiar with it and it could be set up and the information published quickly.

[35] http://cccscoetc.weebly.com/water-quality-management.html


**Figure 4. Pueblo Community College's Mobile Learning Labs**[36]

The use of MLLs is not new to Colorado or to the Colorado Community College System. PCC has used this form of traveling classroom for years in their Economic and Workforce Development Unit. Thus, prior to the COETC grant, PCC had multiple labs deployed for other program areas, such as manufacturing. Under COETC, PCC developed three new labs: one for welding, one to train workers in electrical systems, and one to train workers in mechanical systems. With their new MLLs, PCC has continued their model of serving incumbent workers with non-credit training. After developing company-specific training programs, PCC moves the relevant MLL to the company worksite. Workshops are then scheduled to fit into the company's work shifts and/or lunch or dinner breaks. For these workshops, PCC frequently uses industry-based instructors. Training on or close to site has resulted in many of these instructors being willing to go beyond their workshop assignments to solve problems in real time on the company floor.

RRCC and CMC have developed credit programming that utilizes the MLLs both on and off campus. The on-campus use of MLLs expands the physical capacity of the college's lab space and often offers access to the newest equipment. Off campus, the labs serve as remote classrooms.

For example, CMC's mobile lab has enabled the college to increase face-to-face time with students enrolled in some of its hybrid courses. The college's goal for hybrid delivery was "40 to 45 percent face time and 50 to 55 percent hybrid online learning." Students, however, often expressed the desire for more hands-on time. In response, CMC has expanded the use of their MLL in hybrid courses. The benefits have been multiple, as affirmed by CMC – students have more opportunities for hands-on lab coursework and profit from more real-time interaction with faculty.

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[36] Photo by Suzanne Michael.

The new MLLs have also expanded the capacity of energy colleges geographically. This is especially the case with PCC. Prior to COETC, all PCC MLLs were based in and run out of the main campus in Pueblo. With the addition of the COETC-funded MLLs, PCC is now able to send MLLs to their campus in southwestern Colorado, Southwest Colorado Community College.

Like PCC's provision of on-site trainings, CMC has used their lab for trainings at industry partner sites. CMC has also used its MLL to provide learning opportunities for students enrolled in regional high school STEM programs. In addition, CMC has deployed its MLL to energy market events across the state. RRCC has also taken its MLL on the road. To date, the RRCC mobile learning lab has traveled to three other COETC consortium community college campuses to showcase the WQM equipment and/or to provide training to additional WQM program students, e.g., CMC, OJC, and MCC.

In interviews with the EERC site teams, project teams have indicated that on-campus or off-site the MLLs have proven to be great marketing tools for the colleges and their energy programs. For example, the RRCC lab has been present at various regional community outreach and promotional events, attracting much attention and sparking interest in RRCC's WQM program. The lab has even drawn attention from outside the state. Texarkana College, a community college located in the far Northeastern corner of Texas, has expressed interest in leasing RRCC's MLL.

In addition to expanding the capacity of the energy programs, the MLLs are now perceived as a community resource to assist during emergency situations. For example, RRCC's WQM MLL is registered as a Water/Wastewater Agency Response Network (CoWARN) Emergency Response Laboratory. In the event of an emergency, the MLL will assist the Colorado Department of Public Health and Environment to test water quality. Note that, during the 2013 Colorado floods, the lab was on call but not used.

**MLL Construction**

The construction of MLLs required an enormous amount of time, money, and creativity. Industry partners helped with the design of the labs as well as the identification of needed equipment. In the case of CMC, industry partners demonstrated their investment in CMC's energy programs and the MLL by providing funds ($11,000 from Encana and $15,500 from Shell Exploration and Production Company) as well as donating equipment.

To construct and ready the MLLs, the colleges had to purchase a great deal of equipment, including trailers, trucks, cabinets, and training equipment. These purchases required thought and planning to ensure that the MLLs were both cost effective and efficient. Questions arose about the best use of the space – whether to use modular or permanent units, whether to use a trailer, and the appropriate size of the truck. A few faculty members became very involved in the whole process of design and development. PCC faculty designed and assembled the majority of the equipment that went into the PCC labs. The faculty member in charge of RRCC's MLL was also very hands-on, even hand-building storage units for the glassware so that it would not shatter in transit. CMC faculty carefully designed their trailer with modular units that could be rolled in and out of the trailer so that equipment could be rotated in and out based on course needs. This effort greatly expanded the training options of the CMC lab.

EERC team members attended a showcase for the CMC lab held at one of the COETC grant meetings. As attendees entered and walked around the lab, touching equipment and imagining the possibilities, the EERC team heard comments like "Cool" and "Wow"!

The three MLLs built under the COETC grant are indeed impressive, but they have presented some logistical challenges. Driving the MLL requires a special commercial driver's license, and traveling with the vehicle means that the college has to address issues of logistics and finances, such as where the instructor will stay and how gas and lodging can be paid for with class tuition funds. CMC's instructional designer talked to the EERC team about some of the choices to be made in moving the lab around the state:

> I don't think anyone thought of that ahead of time. Okay, we have this mobile learning lab, and [Instructor 1] is going to use it and [Instructor 2] is going to use it, or whatever. Does [Instructor 2] drive this truck? And does [s/he] sit somewhere for two days because ... how does that work?

Colorado's mountainous regions and steep passes as well as changeable weather are additional challenges that the colleges must address as they schedule the use of the MLLs. The colleges are still working on how to handle these different challenges and how they can logistically and financially use their MLLs in the most productive ways.

Another issue that has emerged with the use of MLLs is their use beyond a college's defined service area. Some faculty and staff worried that the use of MLLs across service areas would cause competition between Colorado community colleges. So far, college presidents have cooperated, and colleges have collaborated. For example, CMC and RRCC have worked together to advertise and recruit students to use their respective mobile labs.

**Alternatives to Mobile Learning Labs**

As mentioned above, Aims and FRCC chose not to pursue the MLL concept and have instead directed grant dollars to the creation of on-campus resources. Both colleges had a myriad of reasons for making this choice, including industry preferences, costs and logistics.

Aims used grant money and industry donations to build and equip a new "state of the art training facility." The project lead described the building as "first rate" and noted that it is useful to draw potential students in to the program: "If you build it, they will come." The new facilities are attracting students to the energy programs, which is essential to developing and sustaining them beyond the COETC grant.

Early in the grant period, FRCC faculty decided that a mobile lab was not technically or financially feasible. FRCC decided instead to invest in creating hybrid and online options and building on-campus lab capacity for hands-on learning. As such, FRCC partnered with Colorado State University (CSU) to create a power plant laboratory. This laboratory will provide training for FRCC students and research opportunities for CSU undergraduates and graduate students. FRCC will use the laboratory for classes such as Power Plant Operations, Steam Turbines, Power Generation, and Instrumentation and Controls. CSU will also utilize the laboratory to support engineering courses and as a platform for research projects. COETC grant funds were used to purchase the equipment needed for the steam turbine power plant. CSU was in charge of installing and housing the equipment. The lab is near completion and is scheduled to open in November 2014.

## CAREER COACH

Under the TAA-COETC grant, the career coach position was established to facilitate the progress of students enrolled in energy programs and to assist them with emergent issues that might inhibit their progress or ability to successfully complete a course of study. The coaches were also to serve the needs of students in development education courses across the consortium. Coaches at the energy colleges therefore saw a mix of energy and developmental education students; see Figure 5 below.

Five of the seven energy colleges recruited full-time career coaches (CMC, FRCC, TSJC, RRCC, and AIMS). NJC and PCC hired part-time coaches, and PCC added a second part-time coach during the second project year. In general, the colleges retained the coaches whom they first employed; however, two energy colleges (NJC and FRCC) lost their original coaches when the individuals were reassigned to other college positions. These two colleges recruited replacement career coaches.[37] Most colleges integrated the CC into the colleges' energy department or program (CMC, RRCC, FRCC, and TSJC). A few colleges, however, made the coach position part of student services (AIMS, NJC, and PCC).

In the TAA grant proposal, coach functions were envisioned to include career counseling and referrals, academic advising related to career choices, and counseling and referrals for a wide range of social and financial support services. In a recent survey, the energy coaches reported that their primary functions have been to provide academic advising and job/interview preparation, followed by career planning and student success skills development. The specific blend of coaching activities reflects a) the nature of existing student support services at their colleges, b) the location of the coaches' offices in relationship to the energy program, c) the

[37] At the time this report was finalized, the project grant has ended and while some colleges retained CC positions for the period of no-cost extension (2014-2015), most of CC were either discharged or transferred to Round 3 CHAMP project.

career coaches' prior experiences, and d) the needs of different cohorts of students, e.g., residential, part-time, and incumbent workers and/or students who also need to complete developmental education requirements.

Career coaches have also provided actual and prospective students and other colleges in the consortium with information about the existing and emerging hybrid and online energy programs. In fact, in several cases, coaches worked together to facilitate the enrollment of a student at one college into an energy course or program at another college. For example, RRCC's coach worked with the coaches from three schools (MCC, OJC, and CMC) in the summers of 2013 and 2014 to facilitate sharing of the MLL. In the summer of 2014, the RRCC coach worked with CMC to facilitate the enrollment of six CMC students in at least one hybrid water quality management course offered by RRCC.

In terms of job preparation, coaches have engaged in a wide array of activities to help graduating students become more proactive and effective in their job searches. This has included helping students with résumés and cover letter writing, doing mock job interviews, and helping them to access and use industry websites and Internet job search sites. Some career coaches also mentored students regarding job networking and the development of "personal marketing strategies."

Internships are a helpful strategy for students to explore a specific career area or industry. Internships also provide students with opportunities to apply their growing knowledge and skills and to gain field experience. Several energy college coaches developed internship sites either directly or through their colleges' internship offices. RRCC required students to meet with the career coach to make sure that they had their résumés developed and core classes completed before they could sign up for an internship. Career coaches have also helped students with job applications and/or helped them to connect with industry recruiters. As of March 2014, CMC, RRCC, FRCC, and TSJC had developed 25 internship agreements and placed 51 students in internship sites.[38]

Additional details about the career coaches' work with energy students will be forthcoming in other EERC reports. For this report, the following graph (Figure 5) shows[39] the distribution of students seen by career coaches at the seven energy colleges.

[38] Quarterly Narrative Progress Report, Quarter Ending March 31, 2014.
[39] "Other" refers to students in other programs.

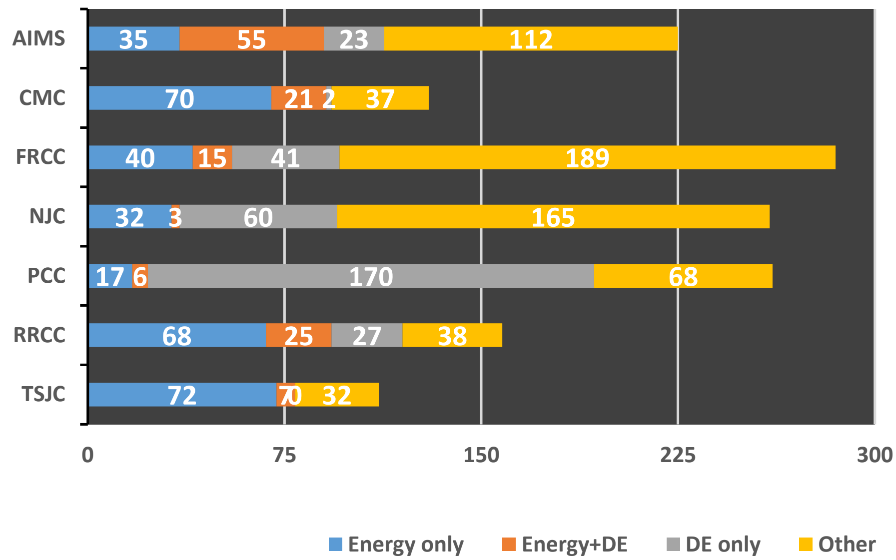


**Figure 5. Students Served at Energy Colleges by Career Coaches, August 2012 to June 2014**

Clearly, caseloads from the coaches at TSJC, RRCC, and CMC were dominated by energy students. Given their advising functions at the other colleges, there is no doubt many of the "other" students (those who were neither developmental education nor energy students) received information about or assistance with contemplating a career in the energy sector.

As part of their responsibilities, career coaches at all the COETC consortium colleges kept electronic student case files (ESCF) about their work with students. Details of all EERC case files will be released as a separate EERC report. For this report, EERC analyzed only the files kept by coaches at energy colleges. We found a significant difference in the rate of completion among students enrolled in an energy course who had at least one meeting with the career coach compared to students who had none (Table 3). Note that some energy students were required to see the coaches as part of their program requirements. In the next few months, we will dig deeper and examine the types of services that the completers received from the coaches.

**Table 3. Comparison of Completion Rates among Students who met with a Career Coach**

| Type of Completer | N | Valid % |
|---|---|---|
| **Completers as a % of 2,723 energy students (all energy schools)** | | |
| AAS-only | 46 | 2% |
| Certificate-only | 202 | 8% |
| AAS and Certificate | 40 | 2% |
| **Completers as a % of 179 students (only completers who met with a CC)** | | |
| AAS-only | 27 | 15% |
| Certificate-only | 129 | 72% |
| AAS and Certificate | 23 | 13% |

## STUDENT OUTCOMES

The primary focus of this section is on completers of COETC energy programs, defined herein as a unique energy participant who completed a program of study (certificate award or AAS degree) during the grant period as defined below. There may be an underreporting of earned versus awarded certificates because students may have earned a credential but failed to apply for one. A higher incidence of underreporting may occur at schools with stackable credentials leading directly to the two-year degree. The analysis that follows does not include students enrolled in non-credit certificate programs at FRCC and PCC because Banner data were not available for the majority of this cohort. Finally, dual enrollees who were high school students were removed from the dataset through one of two methods: a dual enrollee flag set in the college Banner ata or identifying all students younger than 18 years of age.

The analysis that follows proceeds in phases because the data are censored by time. "Censoring" occurs when a value being analyzed occurs outside the range of measurement, as is the case in this analysis for academic terms and wage data (Figure 6). We can report the aggregate number of certificates and degrees earned through summer 2014 based upon the term data available at the time of the data request. When we look at stackable credentials, we report only on credentials earned through spring 2014 because we need to ensure that we have two sequential terms of data, particularly at colleges where the awards extend to 14 weeks or more. We also limited our assessment regarding stacking to non-summer terms since not all the energy colleges offered stacked certificates during the summer sessions. To measure educational retention, we looked at students who earned a degree or certificate through fall 2013 since we had data available through spring 2014. Students retained in education were students enrolled at their home college for one term following completion of a degree or certificate. For the wage analysis, we were able to follow award and degree completers through the spring 2013 term, as we wanted to measure the mean wages earned during the second quarter following completion (Q4-2013). Because of the lagged wage data, the wage analysis was limited.[40]

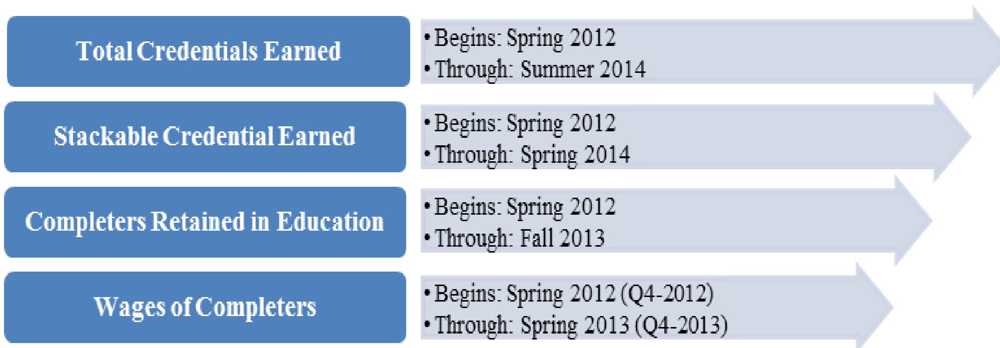


**Figure 6. Start and End Terms for Each Measurement**

[40] USDOL unemployment wage data is only made available three to five months after the quarter being reported.

**Profile of Redesigned Programs**

Beginning at the start of the grant period, spring 2012, 2,570 unique students were enrolled in at least one redesigned course. This number of unique students includes both students enrolled in a credit-bearing energy program and some students enrolled in a non-credit-bearing energy course at PCC. Figure 7 displays the distribution of students enrolled in at least one energy course at the six energy schools that offered credit-bearing certificates and/or AAS degrees. The figure does not include students in non-credit-bearing courses.[41]

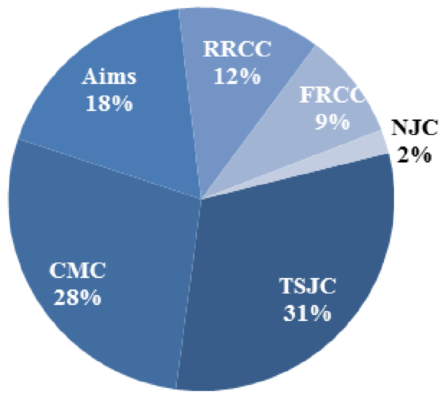


**Figure 7. Energy Students Enrolled in Credit-bearing Programs, Spring 2012 to Summer 2014**

The percentage distribution reflects when colleges implemented their redesigned courses and programs, the length (short- and long-term) of the credentials, and the size of the program at each college. To capture variations in program design and implementation, Figure 8 presents the terms in which students first earned credentials. The shaded area indicates the first term in which a student completed the credential.

[41] PCC did not offer any credit bearing program in energy.

Because of the nature of the non-credit courses at PCC, student-level and course level data was not available at the time of this report. However, EERC can report the number of unique students who completed each course. Table 4 shows 512 unique participants served by PCC's non-credit Energy program as of November 2014. Of those 512 unique participants, 380 completed at least one non-credit course.

**Table 4. Number of Unique Completers by Course**

| **Course** | **Number of Unique Participants Completing the Course**[42] |
|---|---|
| CDL | 30 |
| EMT First Responder | 15 |
| Hydraulics I | 47 |
| Hydraulics II | 8 |
| Industrial Electricity/Print Reading | 90 |
| Industrial Motors & Controls | 43 |
| Mechanical Components | 16 |
| MSHA | 111 |
| Programmable Logic Controllers | 77 |
| Welding - Stick/MIG | 111 |
| **Total** | 548[43] |

[42] A student may have completed the same course more than one time. If so, they are only counted once.
[43] A student may have completed multiple different courses. Therefore, this number does not sum to the total number of unique completers (380) because the total number of unique completers counts a student only once regardless of have many different courses they completed or how many times they completed the same course.

| Redesigned Energy Program of Study<br>Completers by Term | | No. | Spring 11 | Summer 11 | Fall 11 | Spring 12 | Summer 12 | Fall 12 | Spring 13 | Summer 13 | Fall 13 | Spring 14 | Summer 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aims Community College | | 34 | | | | | | | | | | | |
| 102 | Industrial Technology AAS | 1 | | | | | | | | | | | |
| 101 | Engineering Tech AAS Certificate | 4 | | | | | | | | | | | |
| 103 | Industrial Technology Level 1 Certificate | 3 | | | | | | | | | | | |
| 104 | Industrial Technology Level 2 Certificate | 2 | | | | | | | | | | | |
| 105 | Industrial Technology Level 3 Certificate | 0 | | | | | | | | | | | |
| 106 | Industrial Technology Level 4 Certificate | 0 | | | | | | | | | | | |
| 107 | Intro to Oil and Gas Technologies Certificate | 24 | | | | | | | | | | | |
| Colorado Mountain College | | 29 | | | | | | | | | | | |
| 201 | Process Technology AAS | 17 | | | | | | | | | | | |
| 202 | Industrial Instrumentation Controls Certificate | 6 | | | | | | | | | | | |
| 203 | Petroleum Technology Certificate | 2 | | | | | | | | | | | |
| 204 | Photovoltaic Installation Certificate | 2 | | | | | | | | | | | |
| 205 | Basic Solar Photovoltaic Certificate | 2 | | | | | | | | | | | |
| Front Range Community College | | 19 | | | | | | | | | | | |
| 301 | Electro-Mechanical and Energy Technology AAS | 8 | | | | | | | | | | | |
| 302 | Electro-Mechanical and Energy Technology Certificate | 11 | | | | | | | | | | | |
| Northeastern Junior College | | 20 | | | | | | | | | | | |
| 401 | Wind Energy Technician AAS | 20 | | | | | | | | | | | |
| 402 | Wind Technician Core Certificate | 0 | | | | | | | | | | | |
| 403 | Summer Intensive Wind Technician Certificate | 0 | | | | | | | | | | | |
| Red Rocks Community College | | 228 | | | | | | | | | | | |
| 606 | Water Quality Management AAS | 40 | | | | | | | | | | | |
| 601 | Introduction to Water Treatment Certificate | 47 | | | | | | | | | | | |
| 602 | Advanced Wastewater Treatment Certificate | 0 | | | | | | | | | | | |
| 603 | Mathematics in Water Quality Certificate | 53 | | | | | | | | | | | |
| 604 | Laboratory Analysis Certificate | 41 | | | | | | | | | | | |
| 605 | Distribution and Collection Training Certificate | 13 | | | | | | | | | | | |
| 607 | Advanced Water Treatment Certificate | 0 | | | | | | | | | | | |
| 608 | Source Control and Water Audit Certificate | 0 | | | | | | | | | | | |
| 609 | Introduction to Wastewater Treatment Certificate | 31 | | | | | | | | | | | |
| 610 | Education and Experience Certificate | 3 | | | | | | | | | | | |
| TSJC | | 105 | | | | | | | | | | | |
| 701 | Southern Colorado Line Technician AAS | 0 | | | | | | | | | | | |
| 703 | Rocky Mountain Lineman Technician AAS | 0 | | | | | | | | | | | |
| 701 | Southern Colorado Line Technician Certificate | 21 | | | | | | | | | | | |
| 704 | Rocky Mountain Lineman Technician Certificate | 84 | | | | | | | | | | | |

**Figure 8. Program Milestones Reflect When Credentials were First Earned by Students**

As displayed in Figure 8, a small number of students completed their program of study during spring 2012, the first full semester that programs were launched. These credentials were all short in length and could be completed in a single term. The total number of students who completed each of these programs and the terms in which they completed them is included in Appendix B. With the exception of CMC, none of the colleges has had students complete all of its redesigned programs.

As presented in Figure 8, colleges rolled out their redesigned courses and programs at different times over the past three years. The time of launch and the length of the respective credential affected the number of completers. Just 13 credentials were earned in the first term of the grant through summer 2012. This period was followed by a sharp increase to 216 credentials by summer 2013 and a sustained level of 206 credentials through summer 2014. Across the energy colleges, Aims, CMC, and RRCC were among the first energy colleges to see students complete a certificate program (see Figure 8 above).

**Program Completers**

Of the approximately 2,400 unique students enrolled in at least one redesigned credit-bearing course, 288 unique students have earned certificates and/or degrees in credit-bearing redesigned energy programs to date (spring 2012 through summer 2014). Among these students, 242 earned certificate awards and 86 earned AAS degrees for a total of 349 credit-bearing credentials.

In addition, a large number of non-credit certificates were self-reported by the colleges in their submitted USDOL quarterly reports: 340 at PCC and 126 at FRCC. The aggregate number of all awards and degrees earned include 86 degrees, 349 credit-bearing certificates, and 466 non-credit-bearing certificates for a total of 901 credentials. Credit-bearing certificates projected to be earned in fall 2014 include an additional 36 credentials, including six AAS degrees at NJC.

Table 5 presents the distribution of certificates awarded to unique students at each college. Eighty-six AAS students earned degrees through summer 2014. It is notable that almost half of this group (n=40) also earned a certificate as they progressed to their associate degrees. Across the colleges, the largest percentage of dual-credentials was earned at RRCC.

**Table 5. Redesigned Associate's Degrees Earned by Unique Students by College (Spring 2012 through Summer 2014)**

| College | Students (n) | Percent (%) |
|---|---|---|
| Aims Community College | 1 | 1% |
| Colorado Mountain College | 17 | 20% |
| Front Range Community College | 8 | 9% |
| Northeastern Junior College | 20 | 23% |
| Red Rocks Community College | 40 | 47% |
| Trinidad State Junior College | 0 | 0% |
| **Total** | **86** | **100** |

As indicated in Table 6, students at TSJC earned 43 percent and students at RRCC earned 35 percent of all the credit-bearing certificates earned (n=242). When comparing the number of credentials earned at the colleges, it is important to note the differences in certificate program length. For example, some required as few as six credits (at RRCC), while others amounted to 19 credits (at CMC). The length of the certificate likely had an impact on the aggregate number of awards earned or stacked as well as on educational retention.

**Table 6. Redesigned Certificate Award Earned by Unique Students by College (Spring 2012 through Summer 2014)**

| College | Students (n) | Percent (%) |
|---|---|---|
| Aims Community College | 31 | 13% |
| Colorado Mountain College | 10 | 4% |
| Front Range Community College | 11 | 5% |
| Northeastern Junior College | 0 | 0% |
| Red Rocks Community College | 85 | 35% |
| Trinidad State Junior College | 105 | 43% |
| **Total N** | **242** | **100** |

## Stacking Credentials

When we look at stackable credentials, recall that we are only able to report on credentials earned through spring 2014 because we need to ensure that we have two sequential terms of data to report retention, particularly at colleges where the awards extend to 14 weeks or more. Among those who completed an AAS degree, almost half appeared to have earned the degree by stacking their courses (n=40). Of interest is that 30 percent of all degree recipients earned at least one additional certificate, and one student earned five certificates in addition to the AAS (Table 7).

**Table 7. Stacking of Redesigned AAS Degrees and Redesigned Certificates Earned by Unique Students (n=86) (Spring 2012 through Spring 2014)**

| School | All AAS Degrees Earned | AAS Only Completers | AAS + 1 Certificate | AAS + 2 Certificates | AAS + 3 Certificates | AAS + 4 Certificates | AAS + 5 Certificates |
|---|---|---|---|---|---|---|---|
| Aims | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| CMC | 17 | 9 | 8 | 0 | 0 | 0 | 0 |
| FRCC | 8 | 2 | 6 | 0 | 0 | 0 | 0 |
| NJC | 20 | 20 | 0 | 0 | 0 | 0 | 0 |
| RRCC | 40 | 15 | 0 | 11 | 6 | 5 | 3 |
| TSJC | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total N** | **86** | **46** | **14** | **12** | **6** | **5** | **3** |

The largest number of students earning certificate awards were at TSJC (n=105), followed closely by RRCC (n=85). These two schools combined generated 79 percent of all the certificates awarded to date under the grant (Table 8).

Overall, students at most schools earned a single certificate. Only RRCC, Aims, and CMC had students who earned more than one. The highest incidence of stacking certificate awards occurred almost exclusively at RRCC: 24 students earned two certificates, 20 earned three certificates, nine earned four awards, and three students earned five awards (n=31). This is likely correlated to the ability to earn more than one certificate in the same semester. Overall, it appears that non-degree students are not stacking certificates in the same way as students pursuing an AAS degree. This will be an area to explore further during the fourth grant year – do AAS students start with the goal of an AAS, or, as they stack, do they decide also to earn an associate degree?

**Table 8. Stacking of Redesigned Certificates Earned by Unique Students (n=242) by College (Spring 2012 through Spring 2014)**

| School | Total Certificates Earned in Energy Programs | Single-Certificate Earners | Dual-Certificate Earners | Three-Certificate Earners | Four-Certificate Earners | Five-Certificate Earners |
|---|---|---|---|---|---|---|
| Aims | 31 | 29 | 2 | 0 | 0 | 0 |
| CMC | 10 | 8 | 2 | 0 | 0 | 0 |
| FRCC | 11 | 5 | 0 | 0 | 0 | 0 |
| NJC | 0 | 0 | 0 | 0 | 0 | 0 |
| RRCC | 85 | 29 | 24 | 20 | 9 | 3 |
| TSJC | 105 | 105 | 0 | 0 | 0 | 0 |
| **Total N** | **242** | **182** | **28** | **20** | **9** | **3** |

**Profile of Completers by College**

Of the 288 students who earned a degree or certificates, the overwhelming majority was male (97 percent). At NJC and TSJC, all credential earners were male (Table 9). This finding is not surprising given the historical pattern of male employment in the energy sector. However, the percentage of male completers is higher across most schools compared to the percentage of all energy students enrolled in a redesigned class (71 percent).

**Table 9. Percentage by Gender of Completers by College**

| Gender | All Energy Students | All Completers | Aims | CMC | FRCC | NJC | RRCC | TSJC |
|---|---|---|---|---|---|---|---|---|
| **Male** | 71% | 84% | 77% | 63% | 85% | 100% | 74% | 97% |
| **Female** | 29% | 16% | 23% | 37% | 15% | 0% | 26% | 3% |
| **Total N** | 2,566 | 288 | 31 | 19 | 13 | 26 | 100 | 105 |

Table 10 presents the age distribution of students who earned credentials. Almost two-thirds (63 percent) of all award and degree recipients were non-traditional students (students 25 years of age and older). However, the age of the cohort shifted dramatically to younger individuals at NJC (73 percent) and was about evenly divided at TSJC. These results in part reflect that NJC is a residential college offering only an associate's degree in wind energy, while TSJC has one residential AAS degree program in Trinidad and a one-term certificate program in Colorado Springs.

In stark contrast, students at RRCC were dramatically older compared to students at other energy schools. Overall, 11 percent were younger than 23, 13 percent were between the ages of 24 and 29, while 48 percent were between the ages of 30 and 49, and 28 percent were 50 years of age or older.

**Table 10. Percentage of Age of Completers by College**

| Age | All Completers | Aims | CMC | FRCC | NJC | RRCC | TSJC |
|---|---|---|---|---|---|---|---|
| **<25** | 37% | 46% | 21% | 38% | 73% | 13% | 53% |
| **25+** | 63% | 54% | 79% | 62% | 26% | 87% | 47% |
| **Total N** | 284 | 30 | 19 | 13 | 20 | 100 | 105 |

The majority of credential earners were non-Hispanic (see Tables 11 and 12).

**Table 11. Percentage of All Credential Earners by Ethnicity**

| Ethnicity | All Energy Students | Aims | CMC | FRCC | NJC | RRCC | TSJC |
|---|---|---|---|---|---|---|---|
| **Non-Hispanic** | 75% | 42% | 82% | 62% | 82% | 93% | 81% |
| **Hispanic** | 25% | 58% | 18% | NA | 18% | 6% | 19% |
| **Total N** | 2,566 | 31 | 19 | 13 | 20 | 100 | 105 |

**Table 12. Percentage of All Credential Earners by Race**

| Race | All Energy Students | All Completers | Aims | CMC | FRCC | NJC | RRCC | TSJC |
|---|---|---|---|---|---|---|---|---|
| **White, Non-Hispanic** | 60% | 50% | 50% | 58% | 82% | 79% | 85% | 83% |
| **Black, Non=Hispanic** | 4% | 3% | 3% | 5% | 9% | 5% | 3% | 1% |
| **Hispanic** | 25% | 43% | 43% | 16% | 0% | 11% | 6% | 13% |
| **Asian*** | 1% | 3% | 3% | 0% | 9% | 0% | 1% | 1% |
| **Other** | 10% | 1% | 0% | 11% | 0% | 0% | 2% | 2% |
| **Total N** | 2,566 | 277 | 30 | 17 | 11 | 18 | 92 | 102 |

*Includes Pacific Islanders

**Incumbent Workers – Employment and Wages**

Incumbent workers (students who were employed at the time of first enrollment)[44] made up slightly more than one-third of all those who earned degrees or certificates (n=102). Drilling down (see Table 13), one-third of completers earning a certificate were incumbent workers, and slightly more than two-fifths (41 percent) of completers earning an AAS degree were incumbent workers (note that, as cited above, some students earned both). Again, the ratio of completers who were incumbent workers varies from a high of 47 percent at CMC to a low of 26 percent at TJSC.

[44] Note that "employment" does not imply that the student was working in the same field as the field of study but simply was working for wages at the time that he/she enrolled in his/her first redesigned energy course. Further employment at the end of a program of study also does not imply that the student was working in his or her field of study.

**Table 13. Mean Monthly Wage of Incumbent Workers (2nd Quarter after Completion)**

| School | Total Completers | Number of Incumbent Worker Completers | % of Incumbent Worker Completers | Mean Monthly Wages of Incumbent Worker Completers at Start of Program | Mean Monthly Wages of Incumbent Worker Completers Who Were Employed after Completion | Difference in Mean Monthly Wages for Incumbent Workers | Incumbent Worker Completers Employed at Time of Completion |
|---|---|---|---|---|---|---|---|
| **Aims CC** | **31** | **10** | **32%** | **$3,191** | **$4,444** | **$1,253** | **3** |
| AAS only | | | | | | | 0 |
| Certificates only | 30 | 10 | 33% | $3,191 | $4,444 | $1,253 | 3 |
| AAS + Certificates | 1 | 0 | 0% | | $0 | $0 | 0 |
| **CMC** | **19** | **9** | **47%** | **$7,279** | **$13,502** | **$6,223** | **4** |
| AAS only | 9 | 4 | 44% | $9,329 | $22,386 | $13,057 | 1 |
| Certificates only | 2 | 0 | 0% | | | | 0 |
| AAS + Certificates | 8 | 5 | 63% | $5,639 | $10,541 | $4,902 | 3 |
| **FRCC** | **13** | **5** | **38%** | **$3,663** | **$4,162** | **$499** | **4** |
| AAS only | 2 | 0 | 0% | | | | 0 |
| Certificates only | 5 | 1 | 20% | $1,512 | $1,788 | $276 | 1 |
| AAS + Certificates | 6 | 4 | 67% | $4,200 | $4,953 | $753 | 3 |
| **NJC** | **20** | **8** | **40%** | **$1,125** | **$12,949** | **$11,824** | **2** |
| AAS only | 20 | 8 | 40% | $1,125 | $12,949 | $11,824 | 2 |
| Certificates only | 0 | 0 | | | | | 0 |
| AAS + Certificates | 0 | 0 | | | | | 0 |
| **RRCC** | **100** | **43** | **43%** | **$5,536** | **$7,904** | **$2,368** | **20** |
| AAS only | 15 | 7 | 47% | $5,077 | $13,048 | $7,971 | 3 |
| Certificates only | 60 | 27 | 45% | $5,860 | $6,292 | $432 | 11 |
| AAS + Certificates | 25 | 9 | 36% | $4,920 | $8,288 | $3,368 | 6 |
| **TSJC** | **105** | **27** | **26%** | **$1,517** | **$8,021** | **$6,504** | **16** |
| AAS only | 0 | 0 | 0% | | | | 0 |
| Certificates only | 105 | 27 | 26% | $1,517 | $8,021 | $6,504 | 16 |
| AAS + Certificates | 0 | 0 | | | | | 0 |
| **Total** | **288** | **102** | **35%** | **$3,887** | **$8,087.96** | **$4,201** | **49** |
| AAS only | 46 | 19 | 41% | $4,308 | $14,571.56 | $10,263 | 6 |
| Certificates only | 202 | 65 | 32% | $3,578 | $6,860.33 | $3,282 | 31 |
| AAS + Certificates | 40 | 18 | 45% | $4,960 | $8,018 | $3,058 | 12 |

Before discussing the findings here, it is important to mention a caveat: We were only able to follow a subset of students into employment two quarters out because of the lagged reporting of Unemployment Insurance (UI) data, which are only reported here through Q4-2014.

Therefore, we could only follow the wages of students who completed their program of study by summer 2013 or earlier.

In looking at the UI wage data available for the project, it is important to note that we do not know whether the students were at the time of enrollment working full- or part-time or in what industry they were working at either the time of enrollment or after earning a credential. We looked at employment in both the first and second quarters following completion of the educational credential. We compared the first and second quarters subsequent to earning a credential with the students' wages at the time of enrollment and found a positive differences in wages in the second quarter after earning a credential.

While the current data are limited given the wage data lags and credentialing timelines, there are some interesting findings that EERC will follow up on during the fourth and final year of the grant. For example, only about half of all incumbent workers were employed in the second quarter following completion of their credentials/degrees, and, of those who held jobs, only 35 percent had earned an associate's degree, while the remainder had earned certificate awards. What happened to these former workers?

Overall, we found that completers of AAS degrees had a mean wage increase of $8,309 in the second quarter following completion compared to their first-quarter wages. Similarly, recipients of certificate awards saw their mean wages increase by $3,512 compared to their wages at the start of the program. Finally, those with both an AAS degree and a certificate saw their mean quarterly wages increase by $6,054. As expected, wages were higher for incumbent workers who earned a degree credential.

**Non-Incumbent Workers – Employment and Wages**

When it comes to employability, incumbent workers held a decided advantage compared to non-incumbent workers (Table 14). Overall, 60 percent of all incumbent workers were employed in the second quarter following the term of completion, compared to 40 percent of non-incumbent workers. With the exception of FRCC, the employment prospects for non-incumbent workers were lower compared to those of incumbents. For instance, only about a quarter of non-incumbent workers were employed in the second quarter following completion at Aims, NJC, and RRCC. Again, EERC will continue to collect both quantitative and qualitative data to better understand what is happening to these individuals, including an examination of changing trends in industry and regional employment.

**Table 14. Wages of Non-Incumbent Workers in the Second Quarter after Completing a Credential(s)**

| School | Total Completers | Number of Non-incumbent Worker Completers | % of Non-Incumbent Worker Completers | Mean Wages of Non-incumbent Worker Completers Who Were Employed after Completion | Non-Incumbent Worker Completers Employed after Completion |
|---|---|---|---|---|---|
| **Aims CC** | **31** | **21** | **68%** | **$5,187** | **1** |
| AAS-only Completers | 0 | 0 | | | 0 |
| Cert-only Completers | 30 | 20 | 67% | $5,187 | 1 |
| AAS + Cert Completers | 1 | 1 | 100% | $0 | 0 |
| **CMC** | **19** | **10** | **53%** | **$6,104** | **4** |
| AAS Completers | 9 | 5 | 56% | $340 | 1 |
| Cert Completers | 2 | 2 | 100% | $4,138 | 2 |
| AAS + Cert Completers | 8 | 3 | 38% | $15,800 | 1 |
| **FRCC** | **13** | **8** | **62%** | | **0** |
| AAS Completers | 2 | 2 | 100% | | 0 |
| Cert Completers | 5 | 4 | 80% | | 0 |
| AAS + Cert Completers | 6 | 2 | 33% | | 0 |
| **NJC** | **20** | **12** | **60%** | | **0** |
| AAS Completers | 20 | 12 | 60% | | 0 |
| Cert Completers | 0 | 0 | | | 0 |
| AAS + Cert Completers | 0 | 0 | | | 0 |
| **RRCC** | **100** | **57** | **57%** | **$4,890** | **8** |
| AAS Completers | 15 | 8 | 53% | $5,196 | 3 |
| Cert Completers | 60 | 33 | 55% | $3,647 | 3 |
| AAS + Cert Completers | 25 | 16 | 64% | $5,928 | 2 |
| **TSJC** | **105** | **78** | **74%** | **$9,233** | **6** |
| AAS Completers | 0 | 0 | | | 0 |
| Cert Completers | 105 | 78 | 74% | $9,233 | 6 |
| AAS + Cert Completers | 0 | 0 | | | 0 |
| **Total** | **288** | **186** | **65%** | **$6,532.42** | **19** |
| AAS Completers | 46 | 27 | 59% | $3,982.25 | 4 |
| Cert Completers | 202 | 137 | 68% | $6,649.98 | 12 |
| AAS + Cert Completers | 40 | 22 | 55% | $9,218.67 | 3 |

## Retention

We define retention to mean a student enrolled in another course or program in the semester immediately after earning that credential following his or her earning a credential. When we looked at which students continued their education (within their home colleges), we found that some students who earned credentials stayed in school after completing their first credential. Half of all certificate recipients at RRCC continued in education, as did 40 percent of certificate earners at FRCC. We will continue to follow this emerging pattern of energy program certificate earners stacking credentials.

**Table 15. Retention for Completers Subsequent to Earning a Credential**

| School | Total Completers | Completers Retained in Education | Percentage of Completers Retained in Education |
|---|---|---|---|
| **Aims CC** | **31** | | |
| AAS-only Completers | 0 | 0 | 0% |
| Cert-only Completers | 30 | 5 | 17% |
| **CMC** | **19** | | |
| AAS-only Completers | 9 | 1 | 11% |
| Cert-only Completers | 2 | 0 | 0% |
| **FRCC** | **13** | | |
| AAS-only Completers | 2 | 0 | 0% |
| Cert-only Completers | 5 | 2 | 40% |
| **NJC** | **20** | | |
| AAS-only Completers | 20 | 0 | 0% |
| Cert-only Completers | 0 | 0 | 0% |
| **RRCC** | **100** | | |
| AAS-only Completers | 15 | 3 | 20% |
| Cert-only Completers | 60 | 30 | 50% |
| **TSJC** | **105** | | |
| AAS-only Completers | 0 | 0 | 0% |
| Cert-only Completers | 105 | 2 | 2% |
| **Total** | **288** | | |
| AAS-only Completers | 46 | 4 | 9% |
| Cert-only Completers | 202 | 39 | 19% |

## PARTNERSHIPS WITH WORKFORCE CENTERS

The overarching goal of the COETC grant is to prepare students for employment in certain targeted areas of the economy. To achieve this, consortium colleges were required to build relationships with their local workforce centers (WFC). The focal activities of the college–WFC collaborations included building industry relationships, connecting workforce clients to energy training opportunities at community colleges, and helping graduates get placed into careers in energy.

For colleges in the COETC grant, working with workforce centers has been an exercise in building as well as sustaining relationships both institutionally and individually. Different strategies to accomplish this have been used by the energy colleges, including committees, one-on-one relationships, building on existing institutional relationships, and hiring program staff with prior experience with the workforce system. Success in these collaborations has varied a great deal and seemed to depend on both the individuals involved and the fit of the energy program into the larger goals and/or funding abilities of the workforce center.

FRCC attempted to work with three different workforce areas during the grant period. One, the Larimer County Workforce Center, had a representative on a committee that the college set up during the early days of the grant to address post-training employment for students. However, this formal relationship did not yield much in terms of client–student exchange between the college and the WFC.

The FRCC career coach also helped energy students to enroll in Connecting Colorado, the online job search application created by the Colorado Department of Labor & Employment. While this was useful for students, it did not foster more interactions with the Boulder and Adams counties' WFCs. However, over time, the FRCC career coach developed a one-on-one relationship with a workforce system representative with Boulder County, resulting in more referrals between the energy program and the WFC. The career coach observed during an interview that establishing one-on-one relationship was the most successful strategy in linking with WFCs.

Early in the grant, the career coach at RRCC reported that she had established a good relationship with the Jefferson County Workforce Center. Mirroring FRCC relationships, this depended on "one key person." However, in 2013, the WFC staff member changed responsibilities. Ever since, there has been little interaction between the WQM and the workforce center.

Despite having a fairly good relationship with the workforce center at the start of the grant period, the RRCC career coach noted that she felt a "disconnect" between the two organizations, where the WFC referred students to her but never followed up. For example, some potential students interested in RRCC's energy programs were referred by the WFC after a semester had begun. However, when she tried to follow up with these individuals for a new term's registration, the WFC did not follow up. As a result, these individuals missed opportunities to enroll in RRCC's WQM programs.

CMC reported a strong one-on-one, bi-directional relationship with an employee at the local workforce center. The coach described this relationship as "good." They worked together to develop a common referral form that could be used for both job seekers and students seeking WFC services.

Similarly, NJC's career coach noted that she has an excellent relationship with a single WFC case manager. The two have talked a great deal about TAA and Workforce Investment Act (WIA) eligibility and what sorts of services are available at each institution. Eventually, they set up a system whereby the career coach could schedule meetings for the students with the WFC specialist. NJC also established with its WFC a unique program in which local WFC grant funds were used to pay for the insurance that NJC energy students required when they were involved in an internship with local wind energy employers. This program helped to relieve some of the significant insurance costs incurred by employers, eliminating a previous barrier to taking on interns.

Aims chose to hire a career coach who had extensive workforce system background that included more than ten years of experience in employment and training programs in Colorado; e.g., the coach previously worked at the Larimer WFC as a case manager for WIA and TAA-eligible individuals. From this experience and others, the coach brought to her position a rich understanding of the retraining needs of unemployed and dislocated workers. The coach's knowledge of the system helped her to identify the key people at the WFC who would be most useful with student recruitment. This has resulted in a good flow of referrals between the institutions. Further, the coach reports that one of the most effective strategies for recruitment she has developed is attending emergency unemployment compensation meetings at the Larimer County WFC. At these meetings, she meets with job seekers and informs them about programming at Aims. She also has been attending WFC workshops, where she meets potential students. The coach's physical presence at the WFC for each of these meetings and workshops has enabled her to strengthen and solidify her relationships with WFC staff.

Over time, the Aims career coach became the college's point of contact for all WFC referrals. Having a single contact at the college has made it easier for the workforce system to refer students and has enabled better flow between the two institutions.

Prior to the COETC grant, PCC had developed an institutionally based relationship with WFCs in their service region – in Pueblo County and the counties near their Southwestern campuses. In both regions, the college and the WFCs have worked together on other USDOL grants, including an H-1B training grant as well as a Colorado state sector partnership grant. Under COETC, PCC has continued these strong relationships with the workforce system.

Under COETC, PCC has coordinated with the Durango and Cortez WFCs in placing job seekers into mine jobs in the region and enrolling them in PCC mine safety training workshops. The WFCs have helped students with WIA training funds to pay for a part of the mine safety course. However, the PCC team leader remarked that, under WIA funding eligibility guidelines, dislocated workers had to qualify for post-training jobs that paid at least $20.65/hour. In some cases, this requirement has limited the number of individuals who can use these funds.

TSJC's coach has worked with various workforce centers, including those in Colorado Springs, Trinidad, and Walsenburg. The strongest relationship has been developed with the Southern Colorado WFC, with which TSJC created a liaison position. This strategy, also involving a single point of contact, has benefited both the college and the WFC.

PCC and the WFCs have also worked together on internship programs, company staffing, and incumbent worker trainings. In addition, the WFCs have worked with a recruitment agency in Southwest Colorado – Price Mine Service in Cortez – to identify potential employees who might benefit from PCC training.

Finally, TSJC's career coach worked with program faculty and WFC staff on a job fair – a rodeo in which line tech students showcased their skills. Employers at the fair could then immediately interview students whom they thought would fit well with their company needs. This collaboration benefitted students, the college, the WFC, and the employers, many of whom voiced their gratitude for the event.

The experience of the colleges working with local workforce centers illustrates the importance of social capital – the idea that the connections between people provide value beyond what the individuals contribute. Where there were strong relationships with WFCs – or even a single employee at the workforce center– the schools and the workforce system were able to work together for the benefit of students, job seekers, and prospective employers. However, when the individual involved with the college leaves, there can be a real void that is hard to fill. In sum, without a strong relationship between multiple key staff members at each institution, significant challenges emerge in coordinating the various services and opportunities that are available to job seekers.

## FURTHER RESEARCH

In the final year of the grant, the research foci will include a) the use of MLLs, b) college–industry relationships, and c) the post-training activity of certificate and degree completers.

**Use of MLLs:** EERC will examine the costs of MLLs and best practices to ensure their sustained use by the colleges. In addition, we will look at the experiences of faculty and students who have used MLLs.

**Hybrid and online training**: EERC will explore the use of hybrid and online training formats. What are faculty and students' reactions to hybrid and online learning formats? How can these courses be sustained after the grant period, and how will materials be updated to remain relevant to changing requirements within the energy sector?

**Stackable credentials:** EERC will explore the context and process of students' decision making to stack credentials and/or pursue an associate's or bachelor's degree in energy or non-energy programs. What are the factors that contribute to these choices, e.g., increased awareness of industry opportunities or their own capacity to do the work? How does the career coach affect this decision-making process? What factors contribute to students deciding to transfer to four-year colleges subsequent to earning a certificate or degree? What role, if any, does the career coach play in this decision?

**Post-training activities**: EERC will use quantitative data to track participants over time, looking at retention in education, the stacking of credentials, and post-training employment. We will also construct a comparison cohort.

**Wages and employment**: What patterns emerge as we track students for longer periods after earning a certificate and/or degree – are there changes in the percentage employed or in wages? Because the unemployment employment and wage data do not indicate the field of work or part-time/full-time status, we will employ surveys and interviews to gain a better understanding of employment history after credentialing.

EERC will also compare the average treatment effects (redesigned courses and credential programs) of completers with non-redesigned students at each energy college.

**Industry partnerships**: EERC will explore industry perceptions of the COETC redesign process, as well as the processes involved in forging and maintaining college-industry relationships over time. Research in these areas will help to inform post-grant sustainability efforts, as well as the capacity of colleges to continue to provide state-of-the-art training for the energy sector.

## APPENDIX

### Appendix A– List of Acronyms

| | |
|---|---|
| AAS | Associate of applied science degree |
| AAC | Arapahoe Community College |
| Aims | Aims Community College |
| AWEA | American Wind Energy Association |
| CCA | Community College of Aurora |
| CC BY | Creative Commons Attribution 3.0 license |
| CCCS | Colorado Community College System |
| CCD | Community College of Denver |
| CDL | Commercial driver's license |
| CMC | Colorado Mountain College |
| CNCC | Colorado Northwestern Community College |
| COETC | Colorado Online Energy Training Consortium |
| CoWARN | Water/Wastewater Agency Response Network |
| CSU | Colorado State University |
| CTA | Career and Technical Act |
| CTE | Career and technical education |
| D2L | Desire 2 Learn |
| EERC | Education and Employment Research Center |
| FRCC | Front Range Community College |
| HR | Human resource |
| LCC | Lamar Community College |
| MCC | Morgan Community College |
| MLL | Mobile learning lab |
| MW | Megawatts |
| NAICS | North American Industry Classification System |

| | |
|---|---|
| NJC | Northeastern Junior College |
| ODS | Operational data store |
| OER | Open educational resources |
| OJC | Otero Junior College |
| PCC | Pueblo Community College |
| PPCC | Pikes Peak Community College |
| PTC | Renewable Energy Production Tax Credit |
| RPS | Renewable power standard |
| RRCC | Red Rocks Community College |
| SMLR | The Rutgers School of Management and Labor Relations |
| TAA | Trade Adjustment Act |
| TAACCCT | Trade Adjustment Assistance Community College and Career Training |
| TSJC | Trinidad State Junior College |
| USDOL | United States Department of Labor |
| WFC | Workforce center |
| WIA | Work Investment Act |
| WQM | Water Quality Management |

## Appendix B – Glossary of Terms: Data Analysis

| Glossary of Terms: Data Analysis | | |
|---|---|---|
| **Common Name** | **Dataset Name** | **Explanation** |
| Age | Age | Age of Student, rounded down. Age is determined using the start date of the term in which the student first took a redesigned COETC course for the Treatment Group. For the Cohort, it's the age at the beginning of the Cohort |
| Course Pass/Fail (Multiple) | PassFail.1 - PassFail.90 | This describes whether a Student passed or failed a course. C- or higher indicates passing. Withdrawals and system missing will be treated as Fail. |
| Credentials - All | EnergyAwardTotal or EATotal | Any COETC or Energy (cohort) Credential Earned |
| Credentials - Certs less than one year | ShortCred | Any COETC or Energy Certificate Earned taking less than one year to complete |
| Credentials - Certs between one and two years | MidCred | Any COETC or Energy certificate Earned taking between one and two years to complete |
| Credentials - Two year degrees | AASCompleter or AASCert | Any Two Year COETC or Energy Associates Degree Earned |
| Incumbent Completer | IncGrantComplete | Incumbent Worker who is also a Completer (Earning a COETC/Energy Program Certificate or Degree) |
| Incumbent worker | IncWork | Student earning wages when enrolling in first redesigned course of the program. |
| New Credentialed employee | EmployedAfterCompletion | Student who entered employment after receiving a credential. Incumbent worker students do not count |
| Persister - COETC | GrantPersister | Student participated in COETC/Energy two straight semesters. These students by definition cannot be Program Completers. |
| Program Completer | Completer | A Completer is someone who earned a grant-funded credential - Two methods used to determine this: 1) Any entry in First_Cred 2) Any entry in First_Cred that matches with a CHEO Enrollment Term. |
| Student Credentialed and Still Employed | RetainedAfterCompletion | Student is newly employed after receiving a COETC/Energy credential and is still employed after 3 quarters |
| Student Degree Status | FullTime | Degree Status of Student<br>Full Time (12 credit hours or more)<br>Part Time (Less than 12 credit hours) |
| Student Ethnicity | Primary_Ethnicity | Student Ethnicity. Not all schools report 'More than one race'. CCCS Schools combine Pacific Islander with Asian |
| Student Pursuing Further Education | EducationAfterCompletion | A Student Pursuing Further Education is someone earned a grant funded credential and was found to be enrolled in any course (grant funded or not) in the following semester. |
| Students Completing Credit Hours | EarnHours | Unique students earning at least one credit hour in a CHEO course |
| Wages Earned in QX 201X (Multiple) | Q12011 - Q42013: Available Wage Data | QX 201X Wages Earned in 2nd Quarter following completion |

**Appendix C – Table I. Redesigned Energy Programs of Study Completers by Term**

| Redesigned Energy Programs of Study Completers by Term | | Completers | Spring 11 | Summer 11 | Fall 11 | Spring 12 | Summer 12 | Fall 12 | Spring 13 | Summer 13 | Fall 13 | Spring 14 | Summer 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aims Community College** | | **34** | | | | | | | | | | | |
| **102** | **Industrial Technology AAS** | **1** | | | | | | | **1** | | | | |
| **101** | **Engineering Tech AAS Certificate** | **4** | | | | **1** | | | **1** | | | **2** | |
| **103** | **Industrial Technology Level 1 Certificate** | **3** | | | | | | | **2** | | | | **1** |
| **104** | **Industrial Technology Level 2 Certificate** | **2** | | | | | | | **2** | | | | |
| **105** | **Industrial Technology Level 3 Certificate** | **0** | | | | | | | | | | | |
| **106** | **Industrial Technology Level 4 Certificate** | **0** | | | | | | | | | | | |
| **107** | **Intro to Oil and Gas Technologies Certificate** | **24** | | | | | | **3** | **1** | **4** | **6** | **9** | **1** |
| **Colorado Mountain College** | | **29** | | | | | | | | | | | |
| **201** | **Process Technology AAS** | **17** | | | | **1** | **3** | **2** | **3** | **2** | **2** | **4** | |
| **202** | **Industrial Instrumentation Controls Certificate** | **6** | | | | **1** | **1** | **2** | | | **1** | **1** | |
| **203** | **Petroleum Technology Certificate** | **2** | | | | | **1** | | | | | **1** | |
| **204** | **Photovoltaic Installation Certificate** | **2** | | | | | | **1** | **1** | | | | |
| **205** | **Basic Solar Photovoltaic Certificate** | **2** | | | | | | **1** | **1** | | | | |
| **Front Range Community College** | | **19** | | | | | | | | | | | |
| **301** | **Electro-Mechanical and Energy Technology AAS** | **8** | | | | | | | **1** | | | **7** | |
| **302** | **Electro-Mechanical and Energy Technology Certificate** | **11** | | | | | | | **6** | | | **4** | **1** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Northeastern Junior College** | | **20** | | | | | | | | | | | |
| **401** | **Wind Energy Technician AAS** | **20** | | | | | | | **2** | **5** | **3** | **5** | **5** |
| **402** | **Wind Technician Core Certificate** | **0** | | | | | | | | | | | |
| **403** | **Summer Intensive Wind Technician Certificate** | **0** | | | | | | | | | | | |
| **Red Rocks Community College** | | **228** | | | | | | | | | | | |
| **606** | **Water Quality Management AAS** | **40** | | | | | | **5** | **19** | **2** | **3** | **9** | **2** |
| **601** | **Introduction to Water Treatment Certificate** | **47** | | | | | | | **25** | **2** | **5** | **14** | **1** |
| **602** | **Advanced Wastewater Treatment Certificate** | **0** | | | | | | | | | | | |
| **603** | **Mathematics in Water Quality Certificate** | **53** | | | | | **2** | **15** | **14** | **4** | **5** | **13** | |
| **604** | **Laboratory Analysis Certificate** | **41** | | | | **1** | **1** | **7** | **15** | **2** | **5** | **10** | |
| **605** | **Distribution and Collection Training Certificate** | **13** | | | | | **1** | | **1** | **2** | **1** | **8** | |
| **607** | **Advanced Water Treatment Certificate** | **0** | | | | | | | | | | | |
| **608** | **Source Control and Water Audit Certificate** | **0** | | | | | | | | | | | |
| **609** | **Introduction to Wastewater Treatment Certificate** | **31** | | | | | | **1** | **7** | **4** | **7** | **11** | **1** |
| **610** | **Education and Experience Certificate** | **3** | | | | | | | **1** | | **1** | **1** | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TSJC** | | **105** | | | | | | | | | | | |
| **701** | **Southern Colorado Line Technician AAS** | **0** | | | | | | | | | | | |
| **703** | **Rocky Mountain Lineman Technician AAS** | **0** | | | | | | | | | | | |
| **701** | **Southern Colorado Line Technician Certificate** | **21** | | | | | | **6** | | | **15** | | |
| **704** | **Rocky Mountain Lineman Technician Certificate** | **84** | | | | | **23** | **20** | | **21** | **20** | | |