SKILL PROFILES FOR ENERGY MANAGEMENT OCCUPATIONS

Energy Project/Program Management and Commercial Building Energy Analysis

Including:
The Use of Industry-Defined Skill Sets to Assess Energy Curriculum and Programs &
Development and Application of the Core Skills Analysis Tool (CSAT)

June 2014

FOR MORE INFORMATION

Contacts:

Alison Pugh
Edmonds Community College
425.640.1509
alison.pugh@edcc.edu

Alan Hardcastle
WSU Energy Program
360.956.2167
hardcast@wsu.edu

This document is available at www.cleanenergyexcellence.org/skill-panel

This material is based upon work supported by the National Science Foundation under Grant No. 1002931.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

SKILL PROFILES FOR ENERGY MANAGEMENT OCCUPATIONS

Energy Project/Program Management and Commercial Building Energy Analysis

Including:
The Use of Industry-Defined Skill Sets to Assess Energy Curriculum and Programs &
Development and Application of the Core Skills Analysis Tool (CSAT)

June 2014

TABLE OF CONTENTS

Table of Contents

PART II: APPLICATION OF THE FINDINGS

The Use of Industry-Defined Skill Sets to Assess Energy Curriculum and Programs: Development and Application of the Core Skills Analysis Tool (CSAT)

TABLE OF CONTENTS

Tables

Figures

Energy Educators Association members building an educational lattice.

PROJECT FUNDING

This material is based upon work supported by the National Science Foundation under Grant No. 1002931.

DISCLAIMER

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

PERMISSION TO CITE

COPIES OF DOCUMENT

Additional copies of the document can be downloaded at no cost: http://cleanenergyexcellence.org/skill-panel

DOCUMENT CREDITS

Project Team:

Alan Hardcastle
WSU Energy Program
360.956.2167
hardcast@wsu.edu

Alison Pugh
Edmonds Community College
425.640.1509
alison.pugh@edcc.edu

Ron Wheadon
Cascadia College
425.352.8168
rwheadon@cascadia.edu

Thomas Barr
Edmonds Community College
425.640.1295
thomas.barr@edcc.edu

Mel Oyler
Lake Washington Institute of Technology
425.739.8427
moyler@lwtech.edu

ACKNOWLEDGEMENTS

This document is the product of the joint efforts of energy industry employers and representatives from labor, education, and government working collaboratively to address the current and future workforce needs of the energy management industry. A special thanks to all who contributed, and especially to the employers and employees who participated in the focus groups. Their countless hours of work to help produce and verify the skill profiles are greatly appreciated. Many thanks to (former) vice president Mari Anderson and McKinstry, who generously provided meeting facilities, meals, and excellent support for project meetings and focus groups.

INDUSTRY AND LABOR TASK FORCE

Members of the Industry and Labor Task Force were instrumental in providing leadership throughout the three-year Energy Management grant. They also advised and supported the design, implementation, and review of the Skills Profiles project. The Task Force met several times to help design the project from startup through completion of the final document.

Many thanks to the following Task Force members for contributing their expertise, resources, and leadership in support of this project:

- Mari Anderson, McKinstry
- Sean Bagsby, IBEW Local 46
- Syd France, Puget Sound Energy
- Douglas Smith, Meng Analysis
- Mary E. Smith, Snohomish PUD
- Dan Wildenhaus, CLEAResult
- Moe Salem, McKinstry

Focus Group Participants

Separate focus groups were convened to identify the primary work functions, activities, and skills required of professionals responsible for energy project/program management and commercial building analysis. Focus group participants consisted of experienced front-line employees, first-line supervisors, and subject matter experts in one of these two energy management areas of responsibility in Washington state and across the region. The participants met for a full day at McKinstry to help create the skill profiles identified as important by the Industry and Labor Task Force and the research team. The participants determined the critical work functions and key activities performed by competent employees, as well as the critical skills required. Their insights were an invaluable contribution and formed the foundation of this work.

Participants included:

Energy Project/Program Management

- Haida May Malcome, Puget Sound Energy
- Hillary Olson, Snohomish PUD
- Chris Roe, Boeing Co.
- Leslie Jonsson, CDi Engineers
- Mark Nieman, McKinstry
- Brian Hanson, McKinstry
- Jeff Carter, Fluid Market Strategies

Commercial Building Energy Analysis

- Gaurav Mehta, Stantec
- Perry Spring, Clallum County
- Rob Marks, Snohomish PUD
- Chuck Peterson, Snohomish PUD
- Sangeetha Divakar, CDi Engineers
- Mark Lensson, Puget Sound Energy
- Kevin Laycock, EcoFab
- Richard Ma, McKinstry

Special Thanks

Thanks also to the many additional Washington state utilities, energy management companies, and their employees for reviewing the skill profiles and for completing surveys verifying that the profiles truly reflect the knowledge and skill requirements of the energy management industry across the state.

PART I:
RESEARCH AND FINDINGS

Overview

Introduction

The Skill Profiles Project Outcomes

This project is part of a broader initiative funded by the National Science Foundation (NSF) to ensure the availability of a qualified energy workforce now and into the future. With an emphasis on two-year colleges, NSF's Advanced Technological Education (ATE) program focuses on the education of technicians for the high-technology fields that drive our nation's economy. The following are the overall outcomes targeted by this project team:

- Create skill profiles needed for energy management careers that are consistent with the current and future needs of the public, employers, and the economy for two specific areas of occupational responsibility: Energy Program/Project Management and Commercial Building Analysis.
- Verify the focus group input by written survey and other feedback methods, to confirm that the skill profile data is accurate and represents the occupation and industry as a whole.
- Generate a report for energy management employers, labor unions, and educators showing the skill profiles, the development process, and the data used to support the profiles.

Enhancing Programs, Curriculum, and Workforce Quality

The completion of skill profiles described in this document represents phase one of the overall work undertaken by this NSF-funded project. Phase two is the development and improvement of training and curriculum based on the skill profiles. This work, which is described in the second part of this document, uses the skill profiles as the foundation for developing and enhancing postsecondary courses, programs, and assessments.

Collectively, these activities help ensure that college programs are current and relevant to the skill and career needs of energy management professionals, so that Washington state employers have access to a highly qualified energy workforce. The project employed a rigorous development and verification process and the results have been widely disseminated. The project outcomes are appropriate for replication, adaptation, and adoption by interested stakeholders in other states, regions, and nationally.

Context

The Context for Skill Profiles

The energy industry is undergoing significant technological, social, and organizational changes, and these changes pose challenges to the industry's ability to attract, develop, and retain a qualified workforce. Current and future investments in updating the electrical grid, equipping consumers with the ability to monitor and control their own energy use, and a growing interest in integrating renewables and boosting energy efficiency all have implications for the workforce expectations of utilities, energy service companies, and suppliers. Skill profiles provide a systematic approach to help employers and educators identify the nature of those shifting expectations and the associated skill requirements needed by employees now and into the future. In short, skill profiles offer a method to help companies, employees, and education and training institutions understand and adapt to a changing workplace.

Washington state was an early national and regional leader in the development and use of formal methods for identifying the knowledge, skills, and abilities required of employees in certain occupations, such as through the development of industry-defined skill standards, and through efforts to convert that information into enhanced curriculum and training opportunities through processes such as DACUM (Develop a Curriculum) models.

Skill profiles – a derivative of these earlier proven models – are an innovation created directly through this NSF project. While skill profiles are similar to skill standards and DACUM models, they include new features that afford enhanced user flexibility, novel curriculum and training development inputs, and efficient program development tools. These features, described below, are intended to offer an alternative approach aimed at improving the ability of the energy industry, employers, and educators to identify and provide high-quality education and training that will ensure that current and future energy employees are well-equipped to succeed in the modern energy workplace.

What Are Skill Profiles?

Skill profiles are the industry-identified, occupation-specific knowledge, skills, and abilities that an individual needs to succeed in the workplace. These skill profiles are critical to improving workforce skills, keeping pace with technological and market changes, enhancing the competitiveness of energy employers, and supporting employee career development. To be effective, skill profiles must be derived from research and direct input from experienced employees and subject-matter experts (SMEs) who have deep knowledge of the work.

Skill profiles answer two critical questions:

- What do workers need to know and be able to do to succeed in today's workplace?
- What are the highest-priority skills and qualifications needed for success?

With this fundamental information:

- Employers know whom to hire or where to focus their limited training dollars.
- Employees and new entrants to the workforce know how best to improve their own performance.
- Educators know what content students and incumbent workers must master to gain employment and to enhance their careers.

Why Are Skill Profiles Important?

In today's energy workplace, jobs that once were relatively static and narrowly defined have become broader and now require the ability to apply high-performance work processes, an expanded knowledge base, and the ability to rapidly acquire and apply enhanced skills on the job. Because skill profiles reflect changing workplace realities, they are a tool that can be used by applicants and employees to adapt to shifting work requirements and incorporate new learning that will help maximize employee productivity, retention, and career options.

Updating skills and knowledge is now a lifelong endeavor, causing many employers and employees to spend more effort, time, and money on education and training. Skill profiles provide benchmarks for making education and training decisions; shaping curricula; and directing funds toward high-priority, high-impact education and training investments.

Looking across the energy industry, the systematic approach used to develop skill profiles provides a standardized method to identify core skills for specific occupations that can be applied across many organizations. As an industry-wide benchmark, skill profiles provide a tool that ensures greater portability of knowledge and skills across geographic areas, companies, and careers.

Benefits and Uses of Skill Profiles

Skill profiles benefit all stakeholders – business, educators, labor, individuals, and the government. The success of a skill profiles development project and its usefulness to the community depends on the full participation and commitment of all stakeholders. That means a shared commitment to designing, confirming, and implementing the results of skill profile projects within and across partner organizations, and evaluating the effectiveness of these collaborative efforts.

Benefits for Employers

Employers can use skill profiles to establish personnel qualification requirements and job descriptions. Interviews, performance reviews, and productivity can be evaluated and assessed to a higher degree of accuracy and efficacy.

Employers are also able to identify core competencies and their expectations about workers' skills and abilities. By matching skills and competencies to critical work functions and key activities, employers can work in partnership with employees to enhance their skills and pursue greater organizational efficiencies and productivity. In addition, employers use skill profiles to:

- Align personnel qualification requirements with nationally recognized certifications.
- Design or modify employee training.
- Simplify measurement of employee training effectiveness.
- Assess employee skill levels based on industry-defined work elements and priorities.
- Match employee skills to the work that is required.
- More easily document employee skills, training needs, and performance criteria.
- Improve employee satisfaction, morale, and retention by clarifying expectations.
- Improve work quality, productivity, and competitiveness.
- Initiate or enrich partnerships with key labor, education, government, and community stakeholders who can support workforce development at an organization.

Benefits for Educators

Because the competencies, skills, and assessments were identified as being important for job performance and career success by professionals in the field, educators can confidently integrate these elements into their curricula. This use of profile data for curriculum and assessment development is part of a broader process to establish a collaborative working relationship among educators and employers. Important discussions about new program content and delivery, and upgrading existing courses to maximize the benefits and effectiveness for educators and stakeholders, are among the anticipated long-term outcomes.

Educators can use skill profiles to:

- Provide effective, targeted instruction.
- Develop benchmarks for certificates of competence earned by students.
- Communicate to students and other faculty what companies expect of employees.
- Develop and evaluate existing curriculum and programs based on industry needs.
- Develop assessments to evaluate skills, knowledge, and abilities in classrooms and internships.
- Develop a common language on workforce preparation with business and labor.
- Improve relationships with local businesses, labor unions, other educators, and agencies.
- Provide students with current, specific, and highly relevant career education and counseling.

Benefits for Labor Unions

Labor unions can use skill profiles to gain support for company-sponsored worker training programs for their members, and to identify or enhance career pathways for workers within companies and industries. Unions can provide this information to union members and develop strategies to improve employment stability, career mobility, and wage progression.

Skill profiles help unions to:

- Improve member value to the company.
- Provide a greater worker voice in defining occupations and performance goals.
- Link skill profiles to increased training and upward career mobility for union members.
- Assist employers to match employee skills to the work that is required, and enhance these skills as needed.
- Develop skillsbased training and certification initiatives that complement or upgrade existing apprenticeship programs.
- Communicate effectively with employers about worker training and retraining needs.
- Collaborate with education and industry in developing joint programs and initiatives that provide mutual benefits to union members, companies, and workforce development partners.

Benefits for Students and Workers

Skill profiles can be used to assist students in making career choices by providing current, occupation-specific data on industry expectations for success in the workplace. Profiles-based curricula and assessments can be used to provide students with credentials that certify work-readiness, which can help them to negotiate hiring-in at higher rates of pay and achieve faster advancement in their chosen fields.

Workers can use skill profile data to:

- Accurately assess their skills against those required for career advancement,
- Plan for career growth and wage progression, and
- Determine the continuous learning and training they will need to upgrade their skills.

In addition, students and workers can use skill profiles to:

- Achieve greater clarity regarding employer expectations, including what they are expected to know, and how to prepare for work.
- Enter and re-enter the workforce with better control over their options and ability to secure high-skill, high-wage jobs with future career mobility.
- Accurately assess business expectations about the basic workplace competencies and the technical skills and abilities needed to succeed in specific positions and to ensure career advancement.
- Improve mobility and portability of their skills and credentials.
- Document and achieve certification of competence of the skills they gain through experience, school, training, or self-study.
- Enhance their performance and achievement by self-evaluation against known standards.
- Be active contributors to improving work practices, behaviors, and related activities that help make their organizations successful.

Benefits for Government

By helping to provide information that will ensure a better skill match between workers and employers, governments are investing in economic development at regional and state-wide levels. Skill profiles enable state agencies, educational institutions, and workforce development organizations to provide relevant, effective employment and career options that:

- Promote continuous learning and job mobility, and
- Ensure the development of a highly skilled and competitive workforce.

In addition, government can use skill profiles to:

- Target and evaluate the effectiveness of publicly funded education and training.
- Increase opportunities for underrepresented populations by publicizing information that defines the skills required for success and facilitating the adoption of those definitions by industry, labor, education, and training providers.
- Support the creation of high-performance work organizations and practices that contribute to high-skill, high-wage employment and improved living standards for citizens.
- Facilitate collaboration, commitment, and strategic investments in workforce development among educators, labor, and industry.
- Communicate the need and basis for education reform to business, education, labor, and the community-at-large.

Skill Profiles to Curriculum: A Continuous Development Process

The skill profiles generated in this project are designed to be used by:

- Participating education partners to develop or modify energy management-related curriculum at the high school and community college levels, and
- Companies that wish to upgrade internal hiring and qualifications priorities, training programs and assessments, and overall workforce development goals.

By providing the necessary input from industry, this skill profiles document is a first step in the curriculum development process for energy management occupations, and a model for curriculum development for the energy industry as a whole.

To keep current with a rapidly changing workplace, skill profiles need to be re-evaluated and updated regularly, with full partner participation at each step. New technological developments impact the ways that workers organize and apply their skills, including time management, teamwork, and interpersonal relationships. Increased technological complexity may reduce or simplify some job tasks but make others more intricate.

Today's successful energy management employees are challenged to acquire a broader range of analytical, decision-making, and customer service skills, and to stay current with emerging technologies. Ongoing changes like these must be reflected in curriculum in order to meet the needs of industry and to support employment and career development of energy professionals.

Creating and Using Skill Profiles

The following steps were used to create and implement each of the skill profiles. A review of existing skills identification research and standards ensures that prior work is recognized, leveraged, and not duplicated. The day-long focus group process deliberately included industry participants who have extensive, current experience and/or knowledge of the work.

An innovation developed and implemented during this research extended the focus group approach previously used in other applications (DACUMs, skills panels, skill standards, etc.) to include rank ordering of the identified skills and competencies in terms of importance. The importance rankings for the skills and competencies were collected for each focus group participant. The survey of basic work competencies identified the importance of a range of fundamental workplace knowledge and skill, from computer skills to math, time management, problem solving, and teamwork. The skill profiles were verified through a survey process that asked experienced employees from other organizations to rank and comment on each of the critical work functions identified for the occupation.

Step 1: Identifying Skill Profiles

- Compile and research existing requirements, standards, and competencies in related jobs and careers.
- Conduct focus groups comprising experienced energy management employees to identify critical work functions of the target occupations, including the key activities required to support each critical work function.
- Identify, describe, and prioritize the key skills needed to support each critical work function during the focus group process.
- Conduct a survey of focus group participants and other experienced energy management employees to determine the level of basic work competencies (referred to as SCANS, short for the Secretary's Commission on Achieving Necessary Skills, U.S. Department of Labor) required for each job.
- Verify the data gathered from focus groups through an industry-wide survey of experienced employees and SMEs from other companies.
- Disseminate skill profiles information to involved parties from industry, education, and labor for their review, input, and use.

Step 2: Ranking Skills and Competencies

The Pyramid of Competencies was used to help rank the skills and competencies identified in the skill profiles. The knowledge, skills, and abilities depicted in this pyramid are organized into three broad tiers.

- ***Tier I*** represents the broadest level of competencies, and is the set of 16 employability (SCANS) skills, knowledge, abilities, and personal qualities required of all workers to be successful in today's workplace. These are the universal skills that are needed to apply technical knowledge and tools effectively. For example, energy management professionals need to be able to communicate clearly both orally and in writing and have a basic competence in math.
- ***Tier II*** represents technical skills, knowledge, and abilities common to a cluster of jobs an industry or industry sector. For energy management professionals, for example, knowledge of applicable federal, state, and local laws, standards, and codes would be applicable across all sectors.
- ***Tier III*** represents industry-specific technical skills, knowledge, and abilities that are unique to individual jobs or clusters and are the most prone to rapid change. For example, energy management professionals need to continuously upgrade their science knowledge, technology skills, and awareness of energy system and product innovations that are essential to improving energy efficiency, such as advancements in LED lighting, renewable energy, and grid modernization.

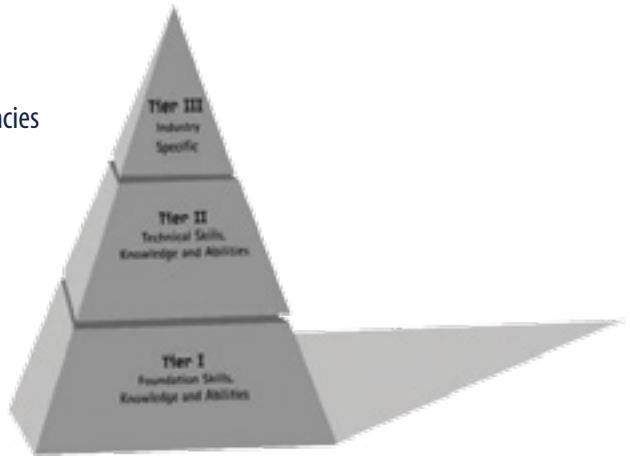


Figure 1. Pyramid of Competencies

Step 3: Developing Curricula and Assessments

The skill profile data provided a useful foundation for curriculum and assessment development by college faculty and industry trainers. In addition to identifying the critical work functions and key activities of these professions, the ranking of the skills and competencies by importance proved valuable for determining which skills and competencies to include or emphasize in curriculum development and assessment efforts.

Because the skills importance rankings are collected from each participant, the statistical variance provides a measure of agreement across different industry representatives and companies. Both pieces of information are available for all skills and competencies (see Appendix A and Appendix B), and are important considerations when designing new courses or modifying existing curriculum.

Energy Management Skill Profiles Project

Goals, Guiding Principles, and Methodology

Goals

- Establish industry-identified skill profiles to advance training options that support energy management activities in organizations and industries.
- Provide market-responsive education and training for individuals taking on new responsibilities in energy management and those seeking entry into energy management occupations.
- Disseminate the results and support the use of skill profiles by educators, businesses, unions, students, workers, and government agencies.

Guiding Principles

- Experienced workers are the experts in their career field and are best able to identify the work performed and the skills, knowledge, and abilities required to be successful.
- Business, labor, education, and government stakeholders must work as partners to ensure the creation of a link between the work expectations and the curriculum.
- Skill profiles must be flexible, encourage course and program portability, and updated regularly.
- Skill profiles describe the major functions and key activities, as well as the technical knowledge and skills, employability skills, and personal attributes needed to succeed in the workplace.
- Skill profiles identify priority rankings for skills relevant to critical work functions, based on focus group input and data analysis.
- Skill profiles should contribute to developing and enhancing energy management curriculum, programs, and assessments that benefit all stakeholders.

Methodology

Background on the Industry and Labor Task Force

In order to reach project goals, it was deemed essential that industry and labor drive the design for establishing the skill profiles because they are the ones who can best define what is needed in the workforce. To help facilitate this process, project researchers requested the participation of energy management industry leaders on an Industry and Labor (I&L) Task Force. The I&L Task Force was designed to be small in number to drive quick work, yet diverse in its membership to ensure that different perspectives were incorporated into the design. (Each of the six members were from different companies or organizations, including two women and one African-American man.)

Project Design

The I&L Task Force met twice in Year 1 to work on the design process. During the first meeting, members reviewed the details of the grant and the process that would be used to build skill profiles. Members discussed possible ways to group the occupational and skills targets in order to maximize the efficiency of the project (as opposed to focusing on one occupation and its corresponding work functions). The Task Force preferred to cluster occupations by function, and the Task Force and research team then developed the following titles for these groupings: program/project management, audit, analysis, and field/ measurement & verification (Table 1):

Table 1. Occupational Groupings Determined by the I&L Task Force

Phase	Program/Project Management	Audit	Analysis	Field or Implementation & Verification
Development	X	X	X	
Design	X	X	X	
Construction	X			X (commissioning)
Operations & Maintenance				X (measurement & verification)

At the second meeting, the Task Force decided the first focus group would center on energy program/project management. This occupation was chosen, in part, because it represents a relatively large number of occupations found in many organizations across the energy efficiency sector, and the knowledge and skills required are transferrable to many other energy-sector jobs. Members brainstormed a list of small, mid-size, and large firms for recruitment to the focus group work. Possible participants from those firms were identified, while also working to include professional, cultural, and gender diversity. Once the Task Force members recruited participants, the first focus group met in 2011 at McKinstry in Seattle, WA.

Several members of the I&L Task Force and a research team member also participated in a panel discussion, called Energy Efficiency in the Built Environment, at the Sixth Annual Energy and Construction Summit, Smarter Grid Innovations 2011 on June 23 in Elma, WA. This conference served to disseminate the goals and activities of the project, and stimulate interest among the nearly 200 industry, labor, and workforce education professionals who attended.

During Year 2, the I&L Task Force met to review the results from the first focus group (Energy Program/Project Management). The results and process were discussed and verified, and a list of additional energy management firms and professionals was created that identified a broader audience of SMEs who could be invited to verify the results via surveys.

The I&L Task Force also recommended that project leaders identify a second occupational work cluster, using the same methodology described above. Literature reviews and input from Task Force members suggested that more people need high-level analytical skills as more data is made available and as improved building performance over time becomes more important within the industry, so Commercial Building Analysis was identified as the second occupational work cluster. This occupational cluster represents both a functional area and occupation, and specific job descriptions vary widely among employers. For this project, this cluster was generally defined to include primarily analysis and auditing functions, with limited exposure to other functional areas such as commissioning and measurement and verification. Again, the I&L Task Force brainstormed a list of firms and professionals to recruit for the focus group, and Task Force members and project leaders recruited participants.

The Commercial Building Analysis focus group met in 2012 at McKinstry in Seattle, WA. The I&L Task Force reviewed and verified the results from the Commercial Building Analysis focus group, and additional energy management firms and professionals were identified to include a broader audience of SMEs who could be invited to verify the results via survey (see below).
The process used to establish skill profiles generated detailed summaries of the knowledge, skills, and abilities required to succeed in energy management occupations. The project/program management and commercial building analysis profiles are now being used by education partners and industry trainers to identify program gaps, and to develop or improve curriculum. These profiles have shown good potential for curriculum development applications in other energy occupations and even outside of the energy field. Skill profiles can also be used to:

- Clearly communicate workplace expectations;
- Increase responsiveness of public education, workforce programs, and service providers;
- Enhance worker employability and portability of skills; and
- Match programs and curriculum to workplace requirements in an industry that is rapidly changing.

Process Detail

These industry-defined skill profiles were developed by adapting specific research-based processes. The project adapted the process specified by the Washington State Board for Community and Technical Colleges (SBCTC), as described in *Skill Standards Guidebook I*,[1] and the process developed by the National Skill Standards Board (NSSB). The primary developmental steps, depicted in Figure 2, are described below.

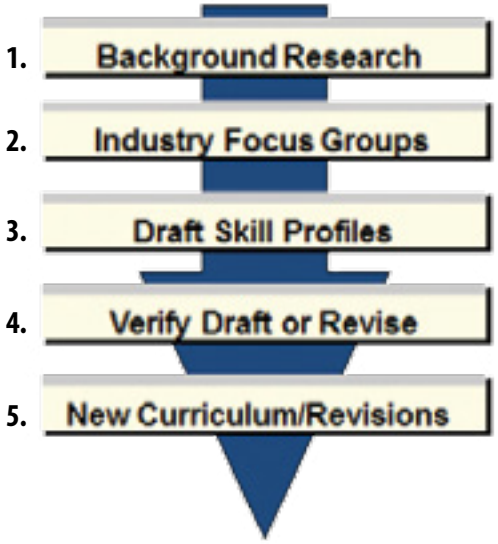


Figure 2. Building and Using Skill Profiles

Dr. Alan Hardcastle of the WSU Energy Program and Ron Wheadon of Cascadia College conducted extensive secondary research to identify trends, current jobs, and existing skill standards and related skills development projects in the energy management industry and the targeted occupational clusters. This information was used to help establish the design and leverage existing research findings; these results were presented and discussed during meetings of the Task Force.

Task Force members:

- Provided input to the research team about the project direction and timeline,
- Advised focus group participants, and
- Approved the initial list of critical work functions and key activities used during the focus groups.

During the focus group, a structured and facilitated process was used to guide the participants through the development of the critical work functions and key activities. Each focus group participant was currently employed in the occupational cluster targeted by the study, or had extensive, current experience and subject matter expertise directly related to the occupation.

1 Washington State Board for Community and Technical Colleges, 1996.

The focus group process included the following elements:

- Focus groups were co-facilitated by Hardcastle and Wheadon, who each have extensive experience in leading group discussions regarding workplace skills, education, and training.
- Participants received an orientation to skill profiles. Examples were provided.
- Participants from several different companies and sites arrived at consensus regarding the components of the skill profiles.
- Participants clarified the organization and structure of the critical work functions and key activities, filled in gaps, confirmed the accuracy of each critical work function and key activities and skills, and established priorities.
- Participants identified occupational technical knowledge and skills for each critical work function.
- Participants prioritized the technical knowledge and skills, then reviewed and discussed the results. Individual scores were collected, analyzed, and graphed.
- Panelists completed a survey to identify and level the Workplace Competencies (SCANS).

After a thorough orientation to skill profiles, participants were asked to brainstorm critical work functions for their cluster. After composing their own critical work functions, participants were then provided with the draft critical work functions identified by the I&L Task Force and research reviews. Participants were asked to compare the critical work functions presented with those they brainstormed as a group, and to consider the following criteria:

- Is the function a broad responsibility?
- Does it take a significant amount of time to achieve?
- Are there groupings of key activities associated with it?

Participants were asked to review the key activities for each critical work function and to posit appropriate changes wherever necessary. The criteria used for this purpose were:

- Does the activity describe what you have to do to achieve this function?
- Is it a major area of task responsibility?
- Is it concrete and specific?
- Does it have relatively equal importance to the other key activities?
- Does each key activity require distinct, definable skills?

Skills and Priorities

Once the critical work functions and key activities were finalized, participants were asked to collectively generate a list of core technical skills they believed were critical to meeting the requirements of each critical work function. This collective list was recorded, and then participants were asked to individually rank-order the importance of each skill in accomplishing the associated critical work function. These individual scores were recorded by the research team, and the results and variations were discussed with the participants. This process

was repeated for each critical work function. In some cases, participants chose to alter their rankings based on the group discussion. These final ranked scores were subsequently coded, analyzed, and converted into a series of graphs that summarize the results (provided in Appendix A).

Surveys

Two survey instruments were used to help establish or verify the skill profiles developed for this project:

- A workplace competencies survey was administered in situ to level SCANS skills and personal qualities for the cluster. SCANS are foundation abilities required of workers in all occupations at varying levels specific to their jobs, ranging from basic academic skills to problem solving, working in teams, and using technology. Surveys were distributed to focus group participants and to a sample of energy management professionals from firms and across the state. Complete survey data from each focus group participant and energy management professional was collected and analyzed. The SCANS survey results for each energy management occupation are presented in the relevant section below.
- A verification survey was used to confirm the content of each skill profile document. Survey respondents were asked to comment on the standards, and to rank the relative importance of the functions and tasks identified by the focus groups. Complete survey data from each focus group participant and energy management professionals from other firms for program/project managers and commercial building analysis professionals was collected and analyzed. The verification survey results for energy management and commercial building analysis are presented below.

Energy project/program management focus group discussing skills.

Definition of Terms

Each chart in the following skill profiles templates contains the following components.

Critical Work Functions

Critical work functions represent the general areas of responsibility for these energy management occupations. The functions tell us what must be done to achieve the key purpose of an occupation or cluster.

Key Activities

Key activities are the tasks related to the functional area of the career cluster and performed by workers in a given occupation. They are made up of work activities that are measurable and observable, and that result in a decision, product, or service.

Employability Skills

Employability skills are basic academic and personal skills that are needed to build more advanced competencies. They are competencies required by all workers in order to obtain meaningful work and participate in the modern workforce.

Level of Importance and Verification

Professionals who are actively working in these occupations rated the level of importance for each critical work function, ranging from not important to critical. All critical work functions were rated and verified as being important, very important, or critical.

Technical Skills, Knowledge, Abilities, and Tools

Technical skills, knowledge, and abilities are those areas of expertise that workers must have in order to perform a given occupational task with excellence. A collection of skills, knowledge, abilities, and tools make up competencies:

- Skills refer to proficiency in an applied activity, which could be physical, mental or interpersonal in nature.
- Knowledge is a particular set of information.
- Abilities are broad human characteristics that result from natural talent, training, or experience.
- Tools are materials, equipment, and implements a worker must be able to use competently to meet the requirements of the job.

Skill Profile for Energy Project/ Program Management

Table 2. Critical Work Functions and Key Activities – Energy Project/Program Management

Energy Program/Project Management							
Critical Work Functions	Key Activities						
A. Manage people	A1 Provide mentorship & training	A2 Fulfill staffing needs	A3 Coordinate stakeholders (vendors, clients, departments)	A4 Conduct project/ program Support	A5 Perform problem solve/conflict resolution	A6 Supervise, delegate tasks, evaluate performance perperformance	A7 Manage third parties
B. Manage budgets	B1 Achieve staffing, resource & equipment management	B2 Manage project schedule	B3 Forecast resource & budget impact	B4 Perform regular program/ project cost analyses	B5 Evaluate effectiveness of project/program	B6 Prepare & manage third party contracts	
C. Develop & implement proposals	C1 Establish scope of work schedule & budget (define exclusions)	C2 Establish project goals, criteria, & deliverables	C3 Identify potential opportunities	C4 Write & present proposals	C5 State professional qualifications for proposal	C6 Coordinate Stakeholders (vendors, clients, departments)	C7 Facilitate project implementation
D. Educate & Train	D1 Vendor education & information exchange about technologies	D2 Pursue professional development/ licensure & certifications	D3 Train clients on installations/ systems	D4 Conduct outreach& advocacy for energy conservation	D5 Mentor direct reports and colleagues	D6 Regularly assess & implement needed training	
E. Direct research, analysis & assessment	E1 Walk through and visually assess sites (facilities/ energy systems)	E2 Perform energy calculations/ modeling	E3 Generate energy conservation measures	E4 Conduct climate analysis	E5 Assess building operations using data logger	E6 Perform utility data analysis	
F. Coordinate external funding & incentives	F1 Research public policy constraints and opportunities	F2 Organize available local & utility rebates & incentives	F3 Coordinate government resources and funding	F4 Leverage tax incentives	F5 Synchronize third party bank financing		
G. Communicate	G1 Track & document work	G2 Perform internal & external Reporting	G3 Facilitate communication among stake holders	G4 Market & promote services and programs (internal & external)	G5 Ensure consistent messaging to clients and the public	G6 Build professional relationships (internal & external)	G7 Manage and document team meetings and actions.
H. Meet regulation policies, codes & standards (internal & external)	H1 Assure quality control	H2 Promote safety awareness	H3 Develop standards & policies as needed	H4 Adhere to professional ethics & company expectations	H5 Promote awareness of regulations, policies, and standards among stakeholders		

Summary of Skill Rankings by Critical Work Function

Skills associated with each critical work function are listed in order of priority, based on the average scores given by the SMEs who participated in the focus group process. Detailed charts of these skill rankings are provided in Appendix A.

Table 3. Skills Rankings by Critical Work Function – Energy Project/Program Management

Critical Work Functions and Associated Skills		
A: Manage People	4. Technology knowledge	13. Metering experience
1. Communication skills: presentation and writing	5. Cost analysis	14. Ability to use and maintain equipment
2. Technical competence	6. Team coordination skills	**F: Coordinate External Funding and Incentives**
3. Motivate people	7. Strategic thinking	1. Knowledge of funding programs
4. Leadership	8. Resource needs	2. Communication
5. Delegation	9. Creative thinking	3. Rapport with external parties
6. Organizational skills	10. Presentation skills	4. Financial acumen
7. Self-starter, self-motivated	11. Sales ability	5. Spreadsheet skills
8. Time management (prioritize effectively)	12. Stakeholder coordination skills	6. Knowledge of current energy code
9. Conflict resolution	13. Research	7. Math skills
10. Team building skills	14. Interviewing skills (as proposer)	8. Organization skills
11. Ability to provide constructive feedback	**D: Educate and Train**	9. Negotiation skills
12. Understanding personal work styles	1. Communication	10. Technical writing skills
13. Recognize employees' performance	2. Technical expertise	11. Knowledge of policy context
14. People sense	3. Ability to identify staff skill needs	**G: Communicate**
15. Strategic thinking	4. Education resources and tools	1. Ability to build and foster relationships
16. Accessibility (open door policy)	5. Presentation	2. Customer outreach
17. Ability to identify staffing and skill gaps	6. Organizational development	3. Listening skills
18. Counsel and advise	7. Track technology trends	4. Technical writing
19. Ability to estimate hours to perform tasks	8. Educational strategies	5. Email skills
B: Manage Budgets	9. Vendor relations	6. Phone skills
1. Excel spreadsheet	10. Provide feedback to employees	7. Presentation skills
2. Technical competencies about the work	11. Coordination skills	8. Negotiation skills
3. Communicating and documenting budgets	12. Multicultural understanding	9. Organizational skills
4. Estimating costs	13. Post-training assessment	**H: Meet Regulations, Policies, Codes and Standards (Internal & External)**
5. Strategies to stay within budgets	**E: Research, Analyze and Assess**	1. Knowledge of codes
6. Estimating hours	1. Technical knowledge	2. Knowledge of regulations
7. Matching employee skills to task	2. Analytical skills	3. Knowledge of standards
8. Math skills	3. Building systems technical knowledge	4. Analysis and interpretation
9. Basic accounting skills	4. Specialize software skills	5. Research skills
10. Ability to identify gaps	5. Applied physics	6. Integrate into design/documentation
11. Understanding 3rd party capabilities	6. Math skills	7. Communication
12. Market analysis	7. Spreadsheet skills	8. Negotiation skills
13. Comparative analysis	8. Plan reading/understanding	9. Understanding of industry best practices benchmarking
C: Develop and Implement Proposals	9. Brainstorming skills	10. Presentation skills
1. Technical writing skills	10. Communication	11. Corrective action
2. Systems knowledge	11. Economic analysis (LCCA)	12. Post-mortem training (lessons learned)
3. Concept development	12. Data management skills	

Employability Skills: SCANS Profile

During the data-gathering process, employability skills for each occupation were identified. Employability, or workplace, skills are the basic academic and foundation skills needed to build more advanced competencies. The foundation skills are based on broad workplace categories, known as SCANS (Secretary's Commission on Achieving Necessary Skills, U.S. Department of Labor). This federal report, issued in 1991, identifies 37 foundation and workplace competencies required for work readiness.

SCANS are comprised of a three-part foundation of skills and personal qualities and five workplace competencies needed for successful job performance in today's workforce. The ADVANCE™ Workplace Standards Skill Inventory from Advanced Educational Spectrums, Inc. was used to capture industry views on foundation skills for energy management professionals.

Professionals currently working in the field were asked to identify the level of difficulty for each of the 37 SCANS most often required for successful workplace performance in each cluster. The summary information in Table 4 provides a general view of the key foundation skills deemed relevant and necessary for energy management professionals with at least three years of industry experience. Table 5 contains information created by taking the average of the profiles across the clusters.

Table 4. Necessary Workplace Skills for Energy Project/Program Management

Basic skills	Thinking skills	Personal qualities	Workplace Competencies
Reading	Creative Thinking	Responsibility	Utilizing Resources
Writing	Decision Making	Self-worth	Interpersonal Skills
Arithmetic	Problem Solving	Sociability	Utilizing Information
Listening	Visualization	Self-management	Using Systems
Speaking	Knows/Learns	Integrity/Honesty	Using Technology

Table 5. Workplace Competencies (SCANS) Survey Results for Energy Project/Program Management

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level.					Critical Competencies
	1	2	3	4	5	
Basic Skills						
Demonstrates Effective Reading Strategies						Identifies relevant details, facts, specifications, follows set of instructions; probes to gain knowledge/information and qualifies/analyzes information.
Demonstrates Effective Writing Strategies						Completes forms, writes simple documents and summarizes/paraphrases information.
Applies Arithmetic Processes						Performs basic computations; records and interprets numerical data.
Applies Mathematics Processes						Utilizes mathematical formulas and processes, summarizes and translates mathematical data.
Demonstrates Effective Listening Skills						Listens attentively, Confirms information and interprets, clarifies and influences communication.
Demonstrates Effective Speaking Skills						Communicates appropriate messages, presents complex ideas and information; analyzes individual responses.

Table 5. Workplace Competencies (SCANS) Survey Results for Energy Project/Program Management (Continued)

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level.					Critical Competencies
	1	2	3	4	5	
Thinking Skills						
Applies Creative Thinking/ Generates Ideas						Paraphrases/summarizes existing ideas, demonstrates creative thinking while problem solving and develops creative solutions.
Applies Decision-Making Strategies						Applies rules and principles to the situation; gathers information and analyzes the situation and information.
Recognizes and Solves Problems						Understands and appropriately refers the complaint or discrepancy; examines information, analyzes possible causes and recommends action plan.
Demonstrates Visualization						Applies appropriate principles to situation and uses previous training and experience to predict outcomes.
Knows How to Learn						Draws upon experiences and prior knowledge, interprets and applies new knowledge and experience.
Applies Reasoning Skills						Identifies facts, principles, problems; applies rules/principles to procedure, uses logic to draw conclusions.

Table 5. Workplace Competencies (SCANS) Survey Results for Energy Project/Program Management (Continued)

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level. 1 2 3 4 5	Critical Competencies
Personal Qualities		
Demonstrates Responsibility		Performs assigned tasks, pays attention to details, works with minimal supervision, demonstrates enthusiasm, optimism and initiative.
Demonstrates Belief in Self Worth		Responds assertively, defends own beliefs and viewpoints; accepts constructive criticism and responsibility for own behavior and understands own impact on others.
Demonstrates Sociability in Groups		Responds appropriately to others; willingly helps others and establishes rapport with co-workers and customers, modifies behavior to environment and shows understanding/empathy for others.
Demonstrates Self-Management		Maintains self-control; demonstrates commitment to self-improvement, and applies self-management skills.
Demonstrates Integrity/ Honesty		Demonstrates honesty and trustworthiness, accepts responsibility for own behavior; demonstrates commitment to personal improvement and recommends ethical course of action.
Management of Resources		
Manages Time		Starts on time; performs a given set of tasks, efficiently manages time and adjusts schedule as required by supervisor.
Manages Money		Reconciles daily receipts and payments; performs routine recordkeeping.
Manages Materials/ Facilities		Maintains job-specific supplies and equipment.
Manages Human Resources		Recognizes job tasks and may distribute work assignments.

Table 5. Workplace Competencies (SCANS) Survey Results for Energy Project/Program Management (Continued)

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level. 1 2 3 4 5	Critical Competencies
Management/Use of Information		
Acquires and Evaluates Information		Selects and obtains information relevant to the task; predicts outcomes and analyzes data.
Organizes and Maintains Information		Interprets information and applies processes to new information.
Interprets and Communicates Information		Recognizes accuracy of information, interprets information, and prepares basic summaries.
Uses Computers to Process Information		Performs basic data entry; utilizes integrated/multiple software tools; locates information and retrieves stored data.
Interpersonal Skills		
Participates as Team Member		Actively participates in team activities and assists team members; demonstrates commitment and works to improve team skills.
Teaches Others		Models proper performance and attitudes; identifies training needs and conducts task-specific training.
Serves Customers		Demonstrates sensitivity to customer concerns and complaints; analyzes customer needs and demonstrates commitment to customer; relates to customer fears and concerns.
Exhibits Leadership		Adheres to standards; encourages others to adopt new concepts; demonstrates commitment to excellence and leads by example.
Negotiates Agreements		Understands negotiations process; identifies conflicts and demonstrates composure; interprets complaints and concerns.
Works with Diversity		Understands the legal aspects of discrimination; respects the rights of others and demonstrates awareness of diversity.

Table 5. Workplace Competencies (SCANS) Survey Results for Energy Project/Program Management (Continued)

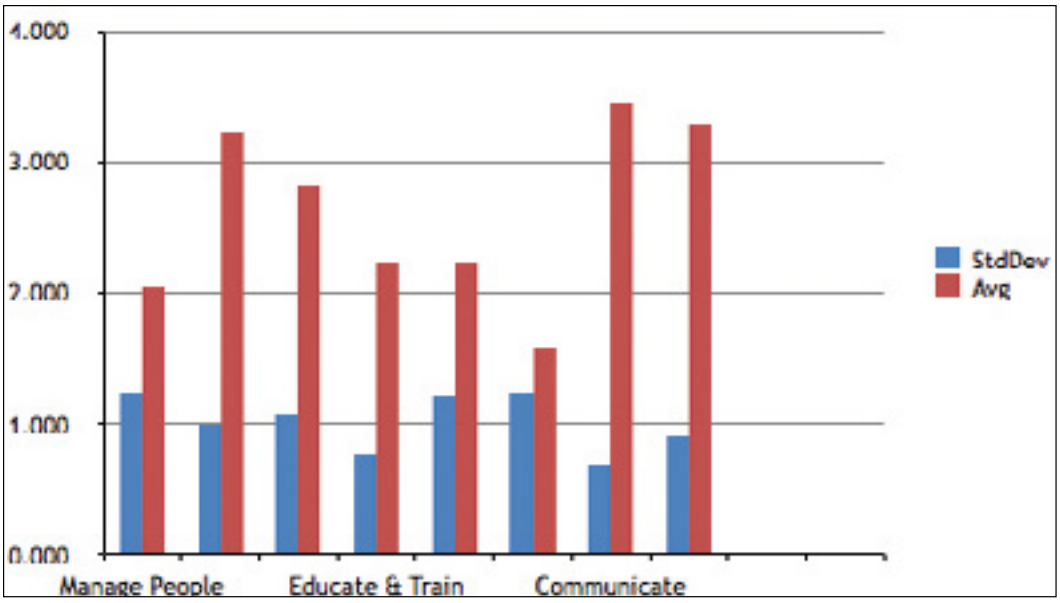
Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level.					Critical Competencies
	1	2	3	4	5	
Understanding/Management of Systems						
Understands System	■	■	■	■		Understands system principles and terminology; understands the organization and system hierarchy and follows processes and procedures.
Monitors/ Corrects System Performance	■	■	■	■		Collects data and identifies system discrepancies.
Improves/ Designs Systems	■	■	■	■		Understands continuous improvement process; identifies needed systemic improvements.
Use of Technology						
Selects Appropriate Technology	■	■	■	■		Know available technology and understands the requirements of the task and technological results.
Applies Technology to Task	■	■	■	■		Understands technology applications and follows proper procedures; understands the operation/interaction.
Maintains/ Troubleshoots Technology	■	■	■			Identifies symptoms and follows maintenance procedures.

Verification Survey Results

Verification surveys were administered to determine if the critical work functions and key activities identified by focus group participants could be verified by a broader sample of SMEs in Washington state. A total of 21 completed surveys were received. Analysis of results for the individual survey items revealed no inconsistent response patterns or scores. Figure 3 shows the average importance and standard deviation (variation) among each function, rated on a scale from 0 (not important) to 4 (critical). These results generally verify that the critical work functions included in the skill profiles document are relevant to the industry at large.

The results show that critical work function G – Communicate – rated highest among all critical work functions, followed by function H – Meet Regulation Policies, Codes and Standards (internal & external). The lowest-rated critical work function was F – Coordinate External Funding and Continuous Learning, followed by function B – Manage the Crew. These two low-ranking critical work functions also showed the largest variation (standard deviation) in scores across all respondents; this variation is only slightly larger than the average for all items, and likely represents variations in responsibility for these functions among different companies. No critical work function had an average value of less than 1.5, which generally confirms that respondents view all eight critical work functions as important or very important to the work of Energy Project/ Program Management.

Figure 3. Average Importance and Variation Among Functions – Energy Project/Program Manager



Typical Job Description – Energy Project/Program Manager

Job Summary

Coordinates critical activities associated with the successful development and execution of specific energy conservation programs, products, or services. The Program Manager is responsible for negotiating and executing promotional and process plans to efficiently and effectively reach program targets within a designated budget. Program management responsibilities and authority related to the programs, products or services, including coordination and managing activities with external and internal vendors, are functions of this job. Large programs may involve multiple projects, vendors and large fiscal requirements, however some programs involve a single product and vendor and budgets of under one million dollars.

Essential Responsibilities

- Build strong relationships with internal and external constituents.
- Develop and manage project tasks and timelines.
- Provide results tracking, reporting, forecasting, and analytical support.
- Identify and resolve problems.
- Strategic focus on program goals.
- Oversee and manage program activities with contractors and consultants.
- Work with manager to create budgets, targets, and work plans.
- Advocate for cost effective energy efficiency measures.

Other Functions

- Prepare reports for internal and external communications.
- Coordinate training activities with internal and external stakeholders.
- Coordinate marketing and promotions activities.
- Prepare invoices for purchasing.
- Audit and verify product installations.
- Facilitate all aspects of meetings with internal and external stakeholders, contractors, consultants, and partners.

Minimum Qualifications

- Three years of experience with program coordination and/or management, including planning and budget responsibility.
- Experience coordinating and/or managing relationships with outside vendors.
- Experience with trade organizations and/or community outreach.
- Strong oral and written communication skills.
- Excellent communication, organization, presentation, and analytical skills.

Desired Qualifications

- Knowledge of energy markets and experience in the utility industry.
- Marketing/sales experience.
- Proficient computer skills with Microsoft Word, Excel, and PowerPoint.
- Technical knowledge, mathematical and analytic skills.
- Desire to work in team environment.
- BA/BS degree in marketing, business, engineering, or equivalent experience.

Skill Profile for Commercial Building Energy Analysis

Table 6. Critical Work Functions and Key Activities – Commercial Building Energy Analysis

Commercial Building Energy Analyst						
Critical Work Functions	Key Activities					
A. Assess requirements and design opportunities	A1 Understand relevant codes, regulations, standards	A2 Site assessment	A3 Interview customer, operators, and users	A4 Identify related business/building development	A5 Research customer's business profile and culture	A6 Apply knowledge of climate/user environment
B. Identify building systems, functions, and interactivity	B1 Facility, equipment inspection, and baseline measurement	B2 Determine level of sophistication of systems and controls	B3 Identify operations & maintenance conditions and personnel	B4 Identify building issues and concerns	B5 Review existing technical documentation and specifications	B6 Define building utilization
C. Energy information modeling and analysis	C1 Identify technology solutions	C2 Analyze utility cost and consumption profiles	C3 Analyze building systems data	C4 Establish energy baselines	C5 Perform energy modeling or simulation and analyze results	C6 Identify and evaluate energy efficiency measures (EEMs)
D. Economic and business case development	D1 Determine cost of EEMs	D2 Determine the value of the energy saved	D3 Conduct life-cycle analysis of EEMs	D4 Determine utility and other incentives (taxes, permitting, etc.)	D5 Assessing the investment value of EEMs	D6 Quantifying environmental benefits (carbon reduction)
E. Present data and opportunities for energy efficiency	E1 Customize results for client needs (bundling/ scenarios)	E2 Present baseline and EEM recommendations	E3 Refine solutions based on client feedback	E4 Develop reports, graphic presentations, and proposals	E5 Support negotiation and contract completion	
F. Communications with customers and other stakeholders	F1 Manage projects	F2 Client education, outreach, and marketing	F3 Coordinating among staff, departments, contractors, and public entities	F4 Advise and interact with customers and other stakeholder groups	F5 Develop or support emerging opportunities (technologies, financial)	F6 Empowering staff in client organizations to achieve EEMs
G. Professional standards, ethics, and leadership	G1 Maintain professional credentials and engage in continuous learning	G2 Participate and contribute to professional and trade organizations	G3 Serve as champion for energy conservation	G4 Mentor colleagues, peers, and students	G5 Participate in updating energy standards and codes	G6 Adhere to professional codes of conduct
H. Measurement, verification, and response	H1 Physical verification of the EEMs	H2 Perform data logging and trending	H3 Develop and implement M&V plan	H4 Respond to findings with corrections or additional measures	H5 Document EEM results with client and share success stories	H6 Identify and share lessons learned with internal stakeholders and industry

Summary of Skill Rankings by Critical Work Function

Skills associated with each Critical Work Function are listed in order of priority, based on the average ratings given by the SMEs who participated in the focus group process. Detailed charts depicting these rankings are provided in Appendix B.

Table 7. Skills Rankings by Critical Work Function – Commercial Building Energy Analysis

Critical Work Functions and Associated Skills		
A: Assess requirements and design opportunities	Understanding modeling tools and limitations	**F: Communications with customers and other stakeholders**
Foundational building systems knowledge	Ability to benchmark calculation results to "rule of thumb" (reality check)	Ability to communicate professionally
Construction and design	Understanding energy economics and rate structures	Strong writing and oral communication skills
Experience with on-site assessment of facilities	Basic understanding of statistics and their application	Ability to set expectations and deliverables
Data gathering and documenting skills	Advanced computer analysis (building simulation modeling software)	Ability to plan, schedule, execute projects and meet deliverables
Knowledge of how to use energy and industry codes	Knowledge of standard energy benchmarking tools (Energy Use Index, Energy Cost Index, Energy Star, Energy Labeling, CBECS)	Ability to collaborate with other technical experts
Interpersonal/interviewing skills	Understanding of energy generation and distribution systems	Ability to adapt to changing circumstances
Planning and organizational skills	Knowledge of metering technologies and understanding load profiles	Ability to conduct an effective inquiry process
Understanding sustainability principles	Ability to use climate data to normalize energy data	Strong mediation, conflict resolution and negotiation skills
Research skills	**D: Economic and business case development**	Ability to facilitate a design/planning process
Knowledge of organizational human behavior	Understanding of project economic analysis methodologies (LCCA, ROI, Simple Payback, discount rate, savings to investment ratio)	Ability to effectively participate in a group environment
B: Identify building systems, functions	Understanding basic business economics and management	Ability to make group presentations to various stakeholders
Foundational building systems knowledge	Ability to evaluate financial tools/resources for projects	Ability to teach clients and other stakeholders the benefits of energy solutions and instruct on particular technology applications
Understanding how different commercial HVAC systems work	Writing and presentation skills	**G: Professional standards, ethics, and leadership**
Knowledge of different building automation systems	Knowledge of construction cost estimation	Ability to self-direct personal professional development
Ability to use basic diagnostic tools	Ability to define and evaluate contractors and proposals	Ability to effectively collaborate with peers and competitors (in the interest of advancing the industry)
Understanding interactions between different building systems	Understanding basic maintenance functions and cost	Ability to understand and interpret technical codes, regulations and protocols
Basic understanding of electricity and how electrical systems work	Ability to quantify/qualify environmental benefits	Ability to understand and apply emerging trends in the industry
Ability to read plans/schematics	Ability to identify and describe non-energy benefits to business operations	Ability to support a learning environment in the workplace
Understanding of facility operations and maintenance services	**E: Present data and opportunities for energy efficiency**	Understanding of relevant professional certifications and credentials
Basic understanding of fluid dynamics	Ability to prioritize and summarize	Understanding of relevant professional associations and opportunities
Ability to ascertain and document assumptions/ estimations (e.g., estimating building/room use patterns	Ability to communicate energy solutions to multiple audiences	Ability to teach and mentor peers, colleagues and students
Psychrometrics	Writing and presentation skills	**H: Measurement, verification, and response**
Knowledge of different lighting techniques	Ability to translate technical information to non-technical audiences	Ability to define relevant M&V to EEM
Ability to assess occupant safety and health impacts of building systems	Ability to align energy solutions to business type and priorities	Ability to define systematic M&V protocols for implementation
Knowledge of personal safety and protection	Ability to show benefits of energy solutions to a business	Understanding trend logging and building automation systems
Knowledge of building toxicity issues (mold, asbestos, lead, etc.)	Ability to communicate and interact with company executives and other stakeholders	Understand and interpret verification reports
C: Energy information modeling and analysis	Basic knowledge of contracts and agreements	Ability to use measurement tools for performance verification
Understand typical energy efficiency measures and how and when to apply them		Ability to write M&V reports
Understanding energy units of measurement		Ability to develop a response plan based on M&V results
Ability to create and manipulate spreadsheets		
Understanding the science of energy modeling (thermodynamics)		

Table 8. Workplace Competencies (SCANS) Survey Results for Commercial Building Energy Analysis

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level.					Critical Competencies
	1	2	3	4	5	
Basic Skills						
Demonstrates Effective Reading Strategies						Identifies relevant details, facts, Specifications; follows set of instructions; probes to gain knowledge/information and qualifies/analyzes information.
Demonstrates Effective Writing Strategies						Records information accurately, writes simple documents and summarizes/ paraphrases information.
Applies Arithmetic Processes						Performs basic computations and measurements, converts numerical data and predicts arithmetic results.
Applies Mathematics Processes						Utilizes mathematical formulas and processes, summarizes and translates mathematical data.
Demonstrates Effective Listening Skills						Listens attentively, responds to non-verbal communication and confirms, interprets, clarifies and influences communication.
Demonstrates Effective Speaking Skills						Actively participates in discussions, explains concepts and presents complex ideas and information.

Table 8. Workplace Competencies (SCANS) Survey Results for Commercial Building Energy Analysis (continued)

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level.					Critical Competencies
	1	2	3	4	5	
Thinking Skills						
Applies Creative Thinking/ Generates Ideas						Recognizes patterns and relationships, demonstrates creative thinking process while problem solving and develops creative solutions.
Applies Decision-Making Strategies						Analyzes situations and information, considers risks and implications and compiles multiple viewpoints.
Recognizes and Solves Problems						Identifies the problem, analyzes possible causes/reasons, recommends action plan and generates/evaluates solutions.
Demonstrates Visualization						Utilizes previous training and experience to predict outcomes; visually analyzes relationship between parts/whole and process/procedure and interprets charts and graphs.
Knows How to Learn						Draws upon experiences and prior knowledge, interprets and applies new knowledge and experience and interprets symbols, diagrams and schematics.
Applies Reasoning Skills						Applies rules/principles to process, uses logic to draw conclusions and analyzes rules and principles.

Table 8. Workplace Competencies (SCANS) Survey Results for Commercial Building Energy Analysis (continued)

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level.					Critical Competencies
	1	2	3	4	5	
Personal Qualities						
Demonstrates Responsibility						Follows policies and procedures, pays attention to details, works with minimal supervision, demonstrates initiative and monitors performance standards.
Demonstrates Belief in Self Worth						Responds assertively, defends own viewpoints, accepts constructive criticism and responsibility for own behavior and understands own impact on others.
Demonstrates Sociability in Groups						Responds appropriately to others, takes active interest in others, establishes rapport with co-workers and customers, modifies behavior to environment and shows understanding/empathy for others.
Demonstrates Self-Management						Accepts responsibility for own behavior, accepts constructive criticism, sets well-defined/realistic goals, demonstrates commitment to self-improvement, and applies self-management skills.
Demonstrates Integrity/ Honesty						Demonstrates honesty and trustworthiness, accepts responsibility for own behavior, analyses societal implications of decisions and recommends ethical course of action.

Table 8. Workplace Competencies (SCANS) Survey Results for Commercial Building Energy Analysis (continued)

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level.					Critical Competencies
	1	2	3	4	5	
Management of Resources						
Manages Time						Effectively manages time; prepares and organizes multiple schedules and manages timelines.
Manages Money						Performs routine recordkeeping.
Manages Materials/ Facilities						Maintains job-specific supplies and equipment, orders and maintains inventory and monitors safe and efficient utilization of materials.
Manages Human Resources						Analyzes work assignments, assesses individual knowledge and skills, determines workload and monitors performance.
Management/Use of Information						
Acquires and Evaluates Information						Selects relevant data, identifies the need for data, predicts outcomes, and integrates multiple items of data.
Organizes and Maintains Information						Interprets information and applies processes to new information.
Interprets and Communicates Information						Recognizes accuracy of information, interprets information, and prepares basic summaries.
Uses Computers to Process Information						Understands computer operation, performs basic data entry, retrieves stored data, and interprets information.

Table 8. Workplace Competencies (SCANS) Survey Results for Commercial Building Energy Analysis (continued)

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level.					Critical Competencies
	1	2	3	4	5	
Interpersonal Skills						
Participates as Team Member						Demonstrates commitment, works to improve team skills, encourages team members, assumes responsibility for accomplishing team goals.
Teaches Others						Conducts task-specific training, coaches others to apply related concepts, provides constructive feedback and develops appropriate training procedures.
Serves Customers						Demonstrates sensitivity to customer concerns and interests; analyzes and responds to customer needs; obtains additional resources to meet customer needs; makes exceptional effort on behalf of customer.
Exhibits Leadership						Leads by example, motivates others to extend their capabilities, displays enthusiasm/positive attitudes and develops majority/minority views.
Negotiates Agreements						Understands negotiations process; identifies conflicts and demonstrates composure; interprets complaints and concerns and analyzes group dynamics.
Works with Diversity						Understands the legal aspects of discrimination; respects the rights of others and demonstrates awareness of diversity; recognizes the value of diversity.

Table 8. Workplace Competencies (SCANS) Survey Results for Commercial Building Energy Analysis (continued)

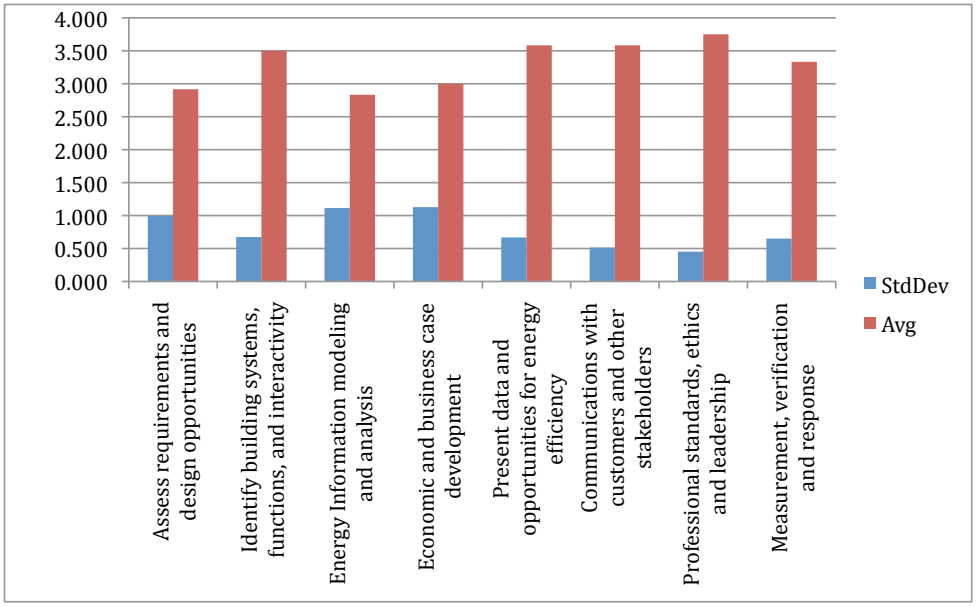
Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level.					Critical Competencies
	1	2	3	4	5	
Understanding/Management of Systems						
Understands System						Understands the organization and system hierarchy and follows procedures and recognizes system strengths and limitations.
Monitors/ Corrects System Performance						Monitors system performance, analyzes system operation, and distinguishes trends in performance.
Improves/ Designs Systems						Suggests system modifications/ improvements and determines system components to be improved.
Use of Technology						
Selects Appropriate Technology						Understands the requirements of the task and technological results and analyzes task/technology relationship.
Applies Technology to Task						Understands technology applications, manipulates technology for desired results and analyzes technology output.
Maintains/ Troubleshoots Technology						Follows specified maintenance, identifies and corrects malfunctions, troubleshoots failures, evaluates performance of technology.

Verification Survey Results

Verification surveys were administered to determine if the critical work functions and tasks identified by focus group participants could be verified by a broader sample of SMEs in Washington state. A total of 13 completed surveys were received. Analysis of results for the individual survey items revealed no inconsistent response patterns or scores. Figure 4 shows the average importance and standard deviation (variation) among each function, rated on a scale from 0 (not important) to 4 (critical). These results generally verify that the critical work functions included in the skill profiles document are relevant to the industry at large.

The results show that critical work function G – Professional Standards, Ethics and Leadership – rated highest among all critical work functions, followed closely by functions B, E and F. The lowest-rated critical work function was C, Energy Information Modeling and Analysis. None of the critical work functions showed large variation (standard deviation) in scores across all respondents. In addition, no critical work function had an average value of less than 2.8, which generally confirms that respondents view all eight critical work functions as important or very important to the work of Commercial Building Energy Analysis.

Figure 4. Average Importance and Variation Among Functions – Commercial Building Energy Analysis



Typical Job Description – Commercial Building Energy Analyst

Job Summary

- Conduct energy audits of buildings, building systems, or process systems.
- Analyze designs for cost effective energy performance.
- May also conduct investment- grade audits of buildings or systems.

Essential Responsibilities

- Conduct inspections and provide technical services, including construction inspections; energy efficiency and sustainable designs; insulation; material interactions and compatibilities; materials engineering; transfer of heat, air and moisture through building envelope; and windows.
- Provide analysis and recommendations for strategic energy initiatives
- Write technical project summaries.
- Collect data and information, and coordinate in useful form for project manager or client.

Minimum Qualifications

- One to two years of work experience in a field related to building design or construction, including envelope, mechanical, and electrical systems.
- Strong analysis skills, including the use of spreadsheets and other software to analyze and report data.
- Strong reading/writing, research, and interpersonal skills.

Desired Qualifications

- BS/BA degree in mechanical engineering, physics, or similar disciplines that provide knowledge of fundamental thermodynamic principles.
- Use of energy modeling software, such as eQuest/DOE 2.2 or EnergyPlus.
- Experience with other analysis tools used in our industry, such as Radiance, WINDOW/THERM, or CFD.
- At least two years of experience in the industry related to building energy systems design, energy audits/evaluations, or energy modeling.
- Basic programming knowledge, any language.
- Familiarity with state and city building energy codes.
- LEED AP or familiarity with LEED and other green building standards.

PART II:
APPLICATION OF THE FINDINGS

The Use of Industry-Defined Skill Sets to Assess Energy Curriculum and Programs: Development and Application of the Core Skills Analysis Tool (CSAT)

Background

Context and Rationale

Edmonds Community College and Cascadia Community College are located about 15 miles apart in northern suburbs of greater Seattle. These grant partners offer two-year degrees in Energy Management (EM) and Environmental Technology and Sustainable Practices (ETSP), respectively. Edmonds' EM program leads to a two-year Associate of Technical Arts (ATA) degree and to an Associate of Applied Science Transfer (AAS-T) degree; Cascadia's ETSP program leads to an Associate of Applied Science (AAS) degree. The two programs are distinct but offer some overlapping course material. Edmonds' emphasis is in energy conservation in buildings. Cascadia's is in sustainable use of energy, materials, land, air and water.

Building upon the work in the previous section of this report, the Core Skills Analysis Tool (CSAT) utilizes the industry-identified skill sets as a reference against which to assess existing courses in energy management. The Development of the CSAT will enable the partners to pursue project goals that include working to enhance and expand complementary course offerings in the field of energy efficiency management, and ensuring that the skill requirements articulated by industry are integrated into the curriculum through the learning objectives, teaching tools and assessments used in energy management programs.

The grant partners from the two colleges' programs have come to work closely together over the last four years. They are aware that students can choose either (or other) institutions. They are also aware that academic funding is limited, and that, where duplication of offerings are eliminated, differentiation of program focus is encouraged, and, where appropriate, cooperation and even integration are enabled, the quality and relevance of the educational experience will be enhanced. To support these ends, the CSAT was developed.

Goals

1. **The grant partners endeavored to develop a tool that can assess the extent to which a college-level academic "energy program" actually teaches the Skills that were identified by the industry focus groups, for each of the two occupational functions, "Energy Project/Program Management" and "Commercial Building Analysis." Supporting this goal were the following design parameters:**
   a. The tool should begin the assessment at the course-level because it is there that skills are taught, and deficiencies can be detected and mitigated.
   b. The tool should utilize the focus groups' priority rankings of the skills within each of its Critical Work Functions. Doing so will allow the establishment of target levels of skill "coverage" against which programs can be assessed based on industry priority.
   c. At the program and inter-program level, the tool should graphically display/detect areas of under-coverage, over-coverage, and redundancy within and between multiple programs.
   d. The tool should be developed in a manner that is feasible within the parameters of the project's budget and time constraints. Specifically, this suggested a self-assessment of each course by each instructor.

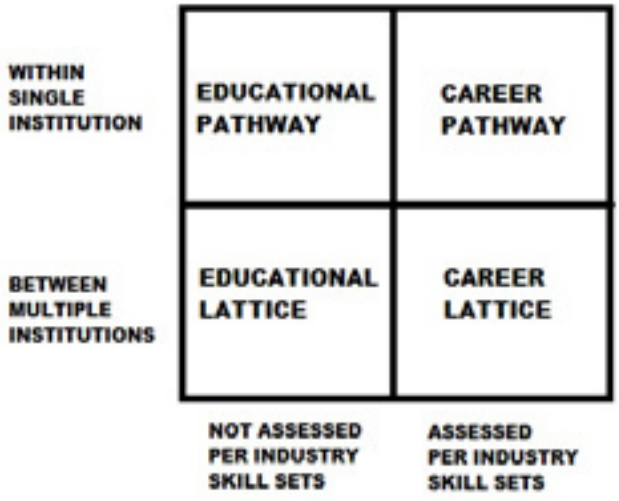
2. **Employed within a college-level academic energy program, the tool can be used to:**
   a. assess overall skill "coverage" for the respective ATA or AAS degrees program and for particular courses.
   b. share with administration, and the program's Technical Advisory Committee to stimulate their pedagogical and professional input.
   c. to help students, in a student advising context, to make informed decisions when choosing their academic programs relative to their career goals.

3. **Employed between two or more partner institutions' energy programs, the tool can be used to help them analyse and compare their respective levels of "coverage." Doing so may enable them to identify:**
   a. Industry-defined skills that are being taught by multiple institutions (potential "duplication");
   b. industry-defined skills taught by none of the institutions (possible "omission");
   c. and patterns in which some industry-defined skills are taught mostly by one, with other such skills taught by another institution ("complementation").
   d. Seeing these patterns may help the institutions to coordinate their offerings and plan for each's respective growth. Here, the differentiation and complementation, afforded by use of the tool, is seen as a strategy that aims to use public resources efficiently by avoiding duplication.

Conceptual Framework – Identification and Assessment of Pathways and Lattices:

The development of a tool which fulfills the twofold goal of allowing faculty, advisors and program planners, to evaluate (1) the extent to which courses within a program teach specific industry-defined skills, and (2) the extent to which curricula between neighboring institutions can be aligned/coordinated to maximize differentiation and minimize duplication, proved to be more complex than initially conceived. This is due to the level of detail (granularity) required to perform a skill assessment and comparative skill analysis that aims for alignment between programs/institutions. There are, as expected, trade-offs between the level of effort necessary to develop a tool and the quality of information that a tool yields. In many cases, the simpler tool may be perfectly adequate for the immediate purpose. In the case of inter-institutional alignment, more highly granular information will yield more accurate results. Accordingly, with the goal of providing the "right tool for the job," the following definitions and distinctions are proposed: "Educational Pathway," "Career Pathway," "Educational Lattice," and "Career Lattice." These can be conceptually arranged in the following manner and with the following definitions:

Figure 5. Definition of Terms Describing Educational Programs



Energy Educational Pathway: This is a configuration of energy courses within a single institution that, together with prerequisites and general education requirements, leads to a certificate or a degree. Choice of skills and outcomes is made by instructors, often in consultation with Technical Advisory Committees (TAC) whose members are chosen from industry and labor. Educational Pathways are familiar and useful constructs, employed by advisors and faculty to guide students through a course of study toward a certificate or degree. Well-defined educational pathways in energy management are in place at Cascadia's ETSP program and at Edmonds' EM program. Both programs have been developed in consultation with a respective TAC. Assessing and making adjustments to a program's curriculum involve incorporating the recommendations of the TAC at whatever level of specificity is appropriate. Assessments here are usually qualitative. The tools used for this activity included official Program Descriptions, Program Requirement worksheets, and course descriptions. Each respective program (in this case, Edmonds and Cascadia,) conducts its own such internal review.

Energy Career Pathway: This is an arrangement of energy courses within a single institution that teaches specific industry-defined skills that have been determined to be essential to performing Critical Work Functions. The goal here is to facilitate mastery of these specific skills in order to increase the probability of job success. When assessing a Career Pathway, existing courses can be quantitatively rated for the extent to which, in the aggregate, they teach the industry-defined skills, and new curricula can be developed as necessary to fill in any gaps. The CSAT was developed to tally and display the results of this effort. (For more on this quantitative process, refer to the first 3 steps in "Energy Career Lattice," below.) Each respective program (in this case Edmonds and Cascadia) conducts its own such internal review.

Energy Educational Lattice: This is an arrangement of courses and/or pathways from two or more institutions that together constitute a route toward an educational goal. Choice of skills and outcomes, as well as the lattice configuration and agreements, are made by an inter-institutional team of instructors and program planners, often in consultation with Technical Advisory Committees (TACs) whose members are chosen from industry and labor. An Educational Lattice is usually developed by non–quantitative means (by simple inspection). It can be, nonetheless, an excellent and practical construct that supports students – who can access both institutions – to identify and pursue unique combinations of certificates and/or a 2-year degree with unique educational emphasis.

For the investigation conducted here, one of the team's first activities was to become qualitatively familiar with each other's energy programs, to the extent of being able to recognize possible Educational Lattices between Edmonds and Cascadia.. The tools that the team used for this activity included official Program Descriptions, Program Requirement worksheets, and course descriptions. Laying them out and inspecting them for patterns of complementarity or redundancy was a fruitful method to explore possibilities for collaboration.

Energy Career Lattice: A "Career Lattice" is the most complex construct because it is a relationship between the programs of two or more institutions that are grounded in specific industry-defined skills. An Energy Career Lattice can give students greater flexibility in designing an energy program that meets their specific needs. When institutions organize their energy programs as a lattice, students can benefit from both programs' diversified offerings.

When assessing the potential for a Career Lattice between two or more energy programs, the pertinent courses of the program can be quantitatively rated for the extent to which they teach the industry-defined skills. Then, these skill scores can be summed to give an aggregate picture of "coverage" for both programs. Areas of over-coverage or under-coverage between the two programs can be determined, and new curricula can be developed, as necessary to fill in any gaps. The CSAT tool supports this effort at a high level of granularity, depending on the number and specificity of the list of industry-defined skills. The CSAT tallies and displays the results of this effort.

The Edmonds/Cascadia investigative team, in collaboration with the WSU Energy Program team, developed the following method for identifying the potential for a career lattice:

- First, a "career area" is identified. This can be in the form of a specific occupation or it can be an occupational function usually identified by industry as a need (i.e. need for more workers and/or need for more definition). In this study, two career areas were selected: "Energy Program/Project Management" and "Commercial Building Analysis."
- Second, a focus group, comprised of experts from industry in the career area, is convened and, among other things, does the following:
  - They develop a list of Critical Work Functions (CWFs) pertaining to the career area.
  - They develop a detailed list of important skills that support each CWF
  - They give each skill an importance rating.
- Third, using the *Core Skills Analysis Tool*, each required energy course contributing to the degree program is assessed for the extent to which it teaches the required skills that were identified by the focus group. For each skill, the courses are scored with two values: the maturity level to which the skill is taught and the extent of exposure of the skill in the course. The result is that each course can be rated on the extent to which it teaches a particular skill. This is called a "coverage" score. Then the sums of the skill coverage scores for one program can be juxtaposed to the sums of the skill scores of another potential lattice partner's program to determine if gaps in one institution's program are complemented by strengths in the other program. If so, a lattice may be possible. Here, the comparison is between potential partners.

Additionally, the sums the coverage scores, for each of the skills embodied across a group of courses in a degree program, can be compared to a target value that is based on the importance ranking of the skill under consideration. Here, the comparison is to a target value.

The Core Skills Analysis Tool (CSAT) specifically supports the Career Lattice development process by identifying existing patterns of duplicated skills (to be possibly pruned out) or complementing skills (to be encouraged), and by designing new differentiating branches that grow both institutions. By building career lattices in this manner, one may determine if, by good fortune, or by making some specific adjustments, multiple sets of courses from different institutions can, together, more fully satisfy industry's and students' needs than either can separately. Building career lattices between institutions acknowledges that, in many cases, the energy field and its subject matter is so broad that no one single institution can "teach it all." Hence the need to work together to develop complementary pathways that truly teach industry-defined skill sets.

Methodology

General Considerations

For each of the two identified career areas (or occupations), the WSU Energy Program team conducted a focus group of industry subject matter experts that developed "Critical Work Functions" (CWFs). The latter are general areas of responsibility that support the key purpose of each energy management occupational function. For each of the Critical Work Functions, the focus groups identified specific skills that support the function. These skills are characterized at a level of granularity by which they are teachable in academic courses. For example, referring to Figure 2 below, consider the identification and location of a particular skill:

> Within the career area ***"Commercial Building Analyst,"***
> there is a Critical Work Function called
> ***"B. Identify building systems, functions, and interactivity"***
>
> And within this CWF, is found the skill called
> ***"B4: Ability to use basic diagnostic tools"***

The latter is an industry-identified skill, the mastery of which is important for a Commercial Building Analyst to perform the Critical Work Function of "identifying building systems, functions, and interactivity." Accordingly, for an academic energy management program to be "industry-relevant" for this career area, the ability to use diagnostic tools ought to be a program outcome, and this skill needs to be taught at the course level. Consequently, for each of the two participant institutions (Edmonds CC and Cascadia CC), the investigative team sought to measure these levels of skill "Coverage" at the course level, then sum these scores to the program level. Only courses that were required for fulfillment of the respective 2-year degree programs were scored for coverage.

The Edmonds/Cascadia investigative team recognized early on that the most practical way to derive the extent to which a skill was "covered" was to have each course instructor make this determination. The principal reason for this is that the instructors know their course content better than anyone. They know

what they teach, how much time they spend on a particular skill, and the level of competency to which they aim their presentations of skills. Other methods of data-gathering (syllabus analysis or classroom observation) were considered, but rejected as being not specific enough, not comprehensive enough, or infeasible given the scope of the grant.

While the investigative team acknowledged that relying on instructors to rate their own skill coverage would admit an element of subjectivity into the assessment, they proceeded with this approach on the condition that instructors would receive a thorough explanation of the purpose of the study, the uses to which the data would be put, that no course was ever expected to teach all industry-defined skills, and therefore, a low score should not be considered "bad."

Orientation to the charts

The course scoring and results display charts for the CSAT were developed in the cloud-based spreadsheet program Google Sheets. The investigative team wanted instructors to have direct internet access to the course-scoring charts and to subsequent results. In this way, they were more likely to be on-board with course-scoring -- viewing the assessment process as a team effort, rather than an isolated event in which they might feel "singled-out" for review.

A separate set of Google Sheets charts was developed for each of the two career areas. These two chart files are titled "CSAT -- Commercial Building Analysis" and "CSAT -- Energy Project/Program Management". **Access to full, working versions of these files are available upon request. Contact Alison Pugh at alison.pugh@edcc.edu.**

Shown next, for purpose of explanation, are selected screenshots of the six charts that constitute the Commercial Building Analysis (CBA) file. Note that the individual charts are identified by tabs along the bottom. Also note that throughout the charts, Edmonds data is shown in varying shades of blue, and Cascadia's in varying shades of green.

Chart 1: CBA Focus Group Data

This includes the CWFs, the Skills, and the ranking data as given by the focus group participants. Importance Factors and Normalized Importance Scores are shown at right.

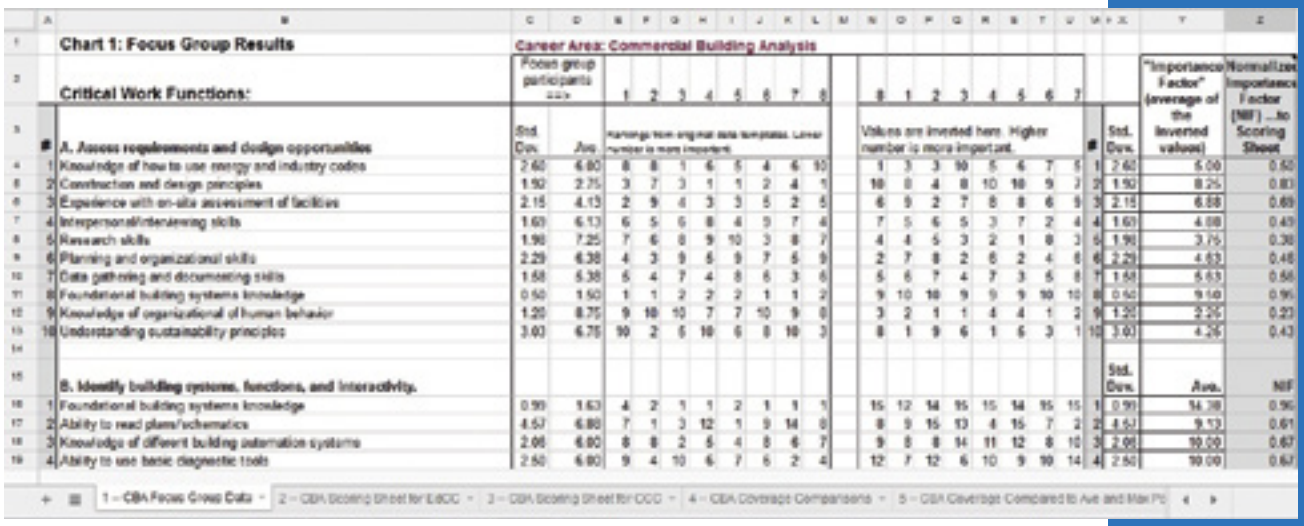


Chart 1: Focus Group Results — Career Area: Commercial Building Analysis

#	Critical Work Functions:	Std. Dev.	Avg.	"Importance Factor" (average of the inverted values)	Normalized Importance Factor (NIF) ...to Scoring Sheet
	A. Assess requirements and design opportunities				
1	Knowledge of how to use energy and industry codes	2.60	6.80	6.00	0.60
2	Construction and design principles	1.92	2.75	8.25	0.83
3	Experience with on-site assessment of facilities	2.15	4.13	6.88	0.69
4	Interpersonal/interviewing skills	1.63	6.13	4.08	0.41
5	Research skills	1.98	7.25	3.75	0.38
6	Planning and organizational skills	2.29	6.38	4.63	0.46
7	Data gathering and documenting skills	1.58	5.38	5.63	0.56
8	Foundational building systems knowledge	0.50	1.50	9.50	0.95
9	Knowledge of organizational of human behavior	1.20	8.75	2.25	0.23
10	Understanding sustainability principles	3.03	6.75	4.25	0.43
	B. Identify building systems, functions, and interactivity.	Std. Dev.	Avg.		NIF
1	Foundational building systems knowledge	0.99	1.63	14.38	0.96
2	Ability to read plans/schematics	4.57	6.88	9.13	0.61
3	Knowledge of different building automation systems	2.66	6.80	10.00	0.67
4	Ability to use basic diagnostic tools	2.50	6.80	10.00	0.67

Figure 6. Portion of Chart 1 – CWFs, Skills, Importance Rankings, and Importance Factors

Chart 2: CBA Scoring Sheet for EdCC

The course-scoring for Edmonds takes place on this blue sheet. The CWFs, with their associated Skills appear down the left side, and program courses appear across the top. Scores for each course are shown in the white fields.

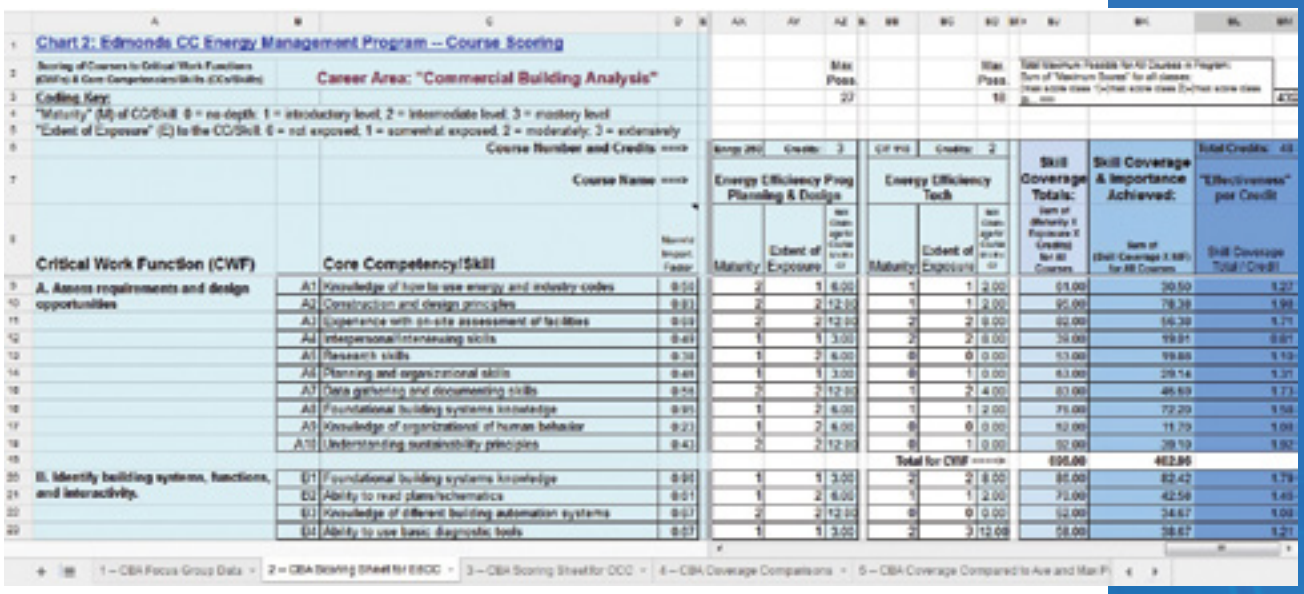


Chart 2: Edmonds CC Energy Management Program -- Course Scoring — Career Area: "Commercial Building Analysis"

"Maturity" (M) of CC/Skill: 0 = no-depth; 1 = introductory level; 2 = intermediate level; 3 = mastery level
"Extent of Exposure" (E) to the CC/Skill: 0 = not exposed; 1 = somewhat exposed; 2 = moderately; 3 = extensively

Critical Work Function (CWF)		Core Competency/Skill	Energy Efficiency Prog Planning & Design: Maturity	Energy Efficiency Prog Planning & Design: Extent of Exposure	Energy Efficiency Tech: Maturity	Energy Efficiency Tech: Extent of Exposure	Skill Coverage Totals:	Skill Coverage & Importance Achieved:	"Effectiveness" per Credit
A. Assess requirements and design opportunities	A1	Knowledge of how to use energy and industry codes	2	1	1	1			
	A2	Construction and design principles	2	2	1	1			
	A3	Experience with on-site assessment of facilities	2	2	2	2			
	A4	Interpersonal/interviewing skills	1	1	2	2			
	A5	Research skills	1	2	0	0			
	A6	Planning and organizational skills	1	1	0	1			
	A7	Data gathering and documenting skills	2	2	1	2			
	A8	Foundational building systems knowledge	1	2	1	1			
	A9	Knowledge of organizational of human behavior	1	2	0	0			
	A10	Understanding sustainability principles	2	2	0	1			
					Total for CWF		696.00	462.90	
B. Identify building systems, functions, and interactivity.	B1	Foundational building systems knowledge	1	1	2	2			
	B2	Ability to read plans/schematics	1	2	1	1			
	B3	Knowledge of different building automation systems	2	2	0	0			
	B4	Ability to use basic diagnostic tools	1	1	2	3			

Figure 7. Portion of Chart 2 -- Course-Scoring Sheet for Edmonds' EM Program

Chart 3: CBA Scoring Sheet for Cascadia

The course-scoring for Cascadia takes place on this green sheet. The CWFs, with their associated Skills appear down the left side, and program courses appear across the top. Scores for each course are shown in the white fields.

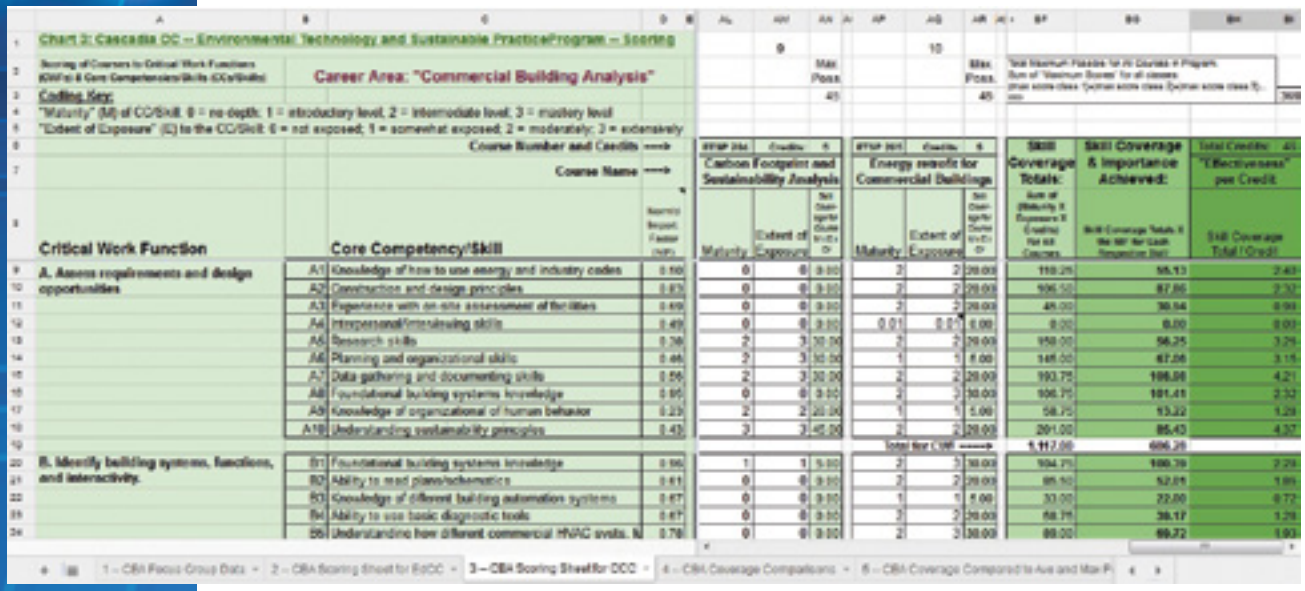


Figure 8. Portion of Chart 3 – Course-Scoring Sheet for Cascadia's ETSP Program

Chart 4: CBA Coverage Comparisons

Graphical comparison of the sums of Edmonds' and Cascadia's "Coverage" scores are shown below. Note: The intensity of the color in column G indicates the relative coverage between the two programs. Grey indicates similar coverage.

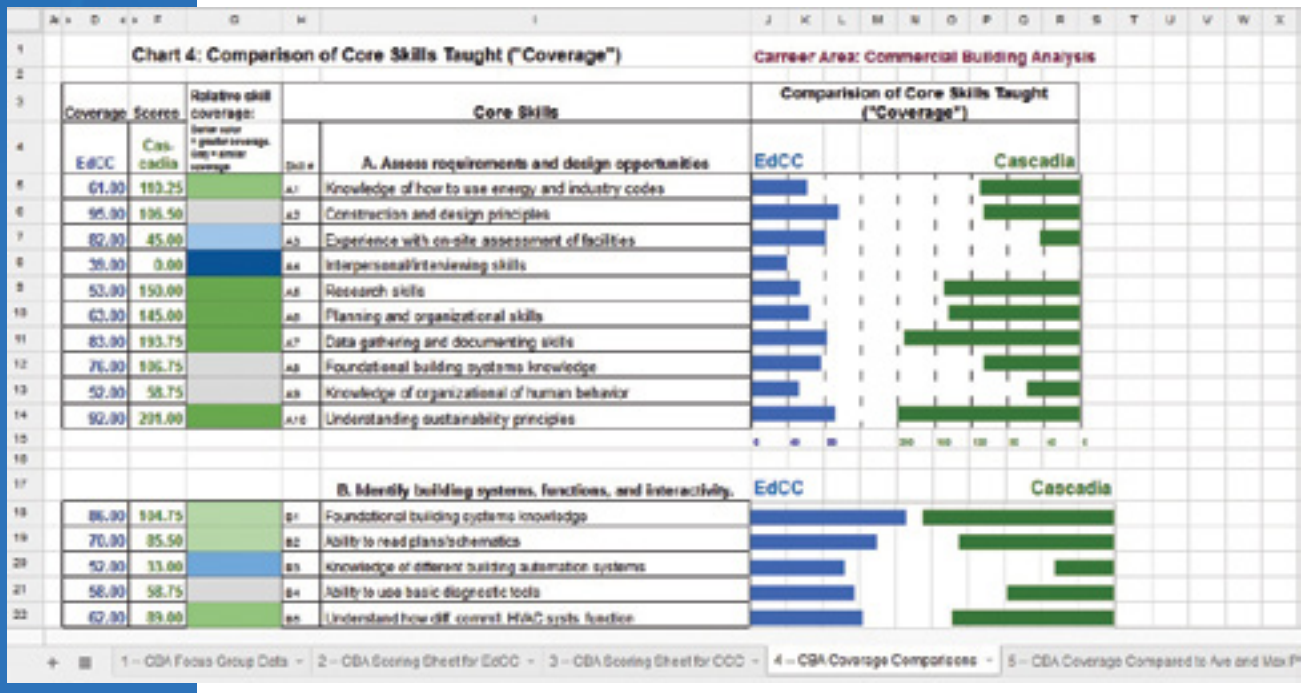


Figure 9. Portion of Chart 4 – Comparison of Summed Coverage Scores

Chart 5: CBA Coverage Compared to Avg and Max Possible

Chart 5 shows bar graphs (in shades of red, blue and green) comparing Edmonds' and Cacadia's coverage scores against a Scaled Averaged Target and Maximum Possible Targets for each skill, rank-ordered by importance factor. Yellow highlighting flags those skills that are "under-covered" relative to the Scaled Averaged Target. To save space in this report, Chart 5 is not shown at the end with the other charts. Instead, the "undercoverage" results of Chart 5 have been summarized in tables titled "Summary of Chart 5" Undercovered Core Skills.

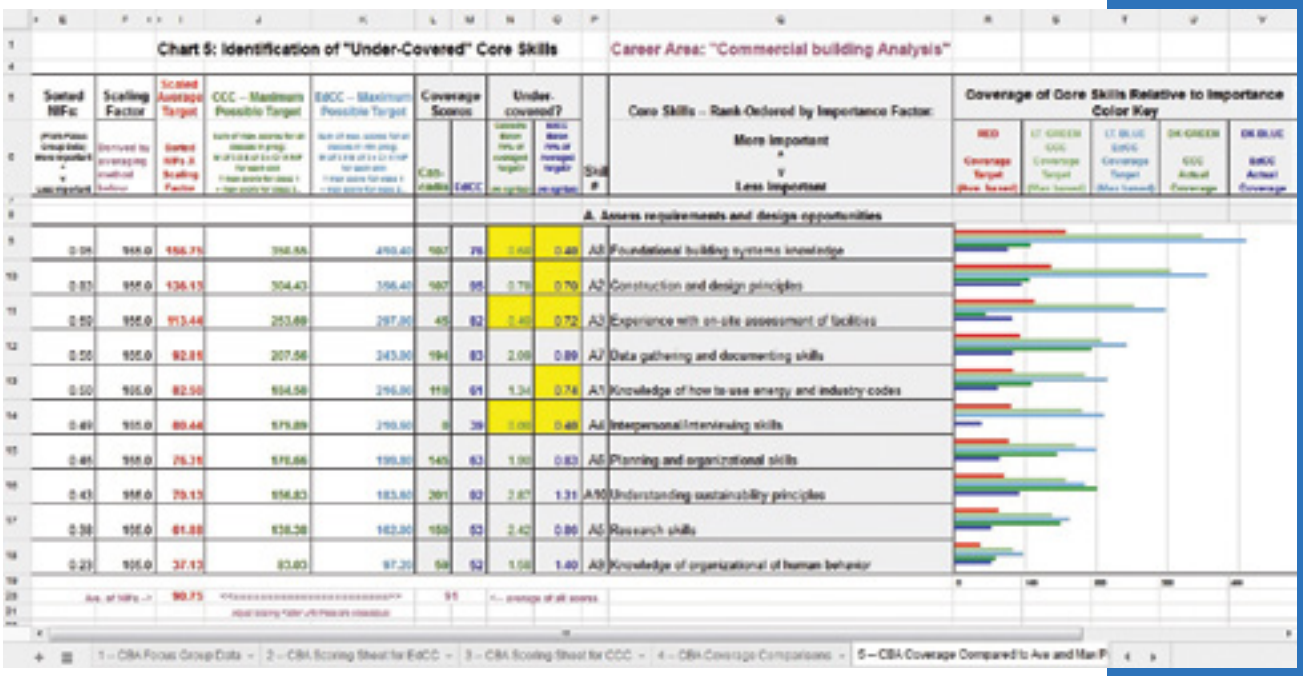


Figure 10. Portion of Chart 5 -- Rank-Ordered Skills Against Average and Maximum Targets

Chart 6: CBA Severity of Undercoverage at the CWF Level
This is a summary chart comparing two cooperating programs. For each program, it measures the percentage of the most important skills, within each CWF, that are undercovered. If, for each CWF, 50% or more of the top 50% importance-ranked skills are undercovered, then that CWF's score is highlighted. CWF's in which both programs are severely undercovered are readily identifiable. This is significant, in that a student will not be exposed to this skill at either program.

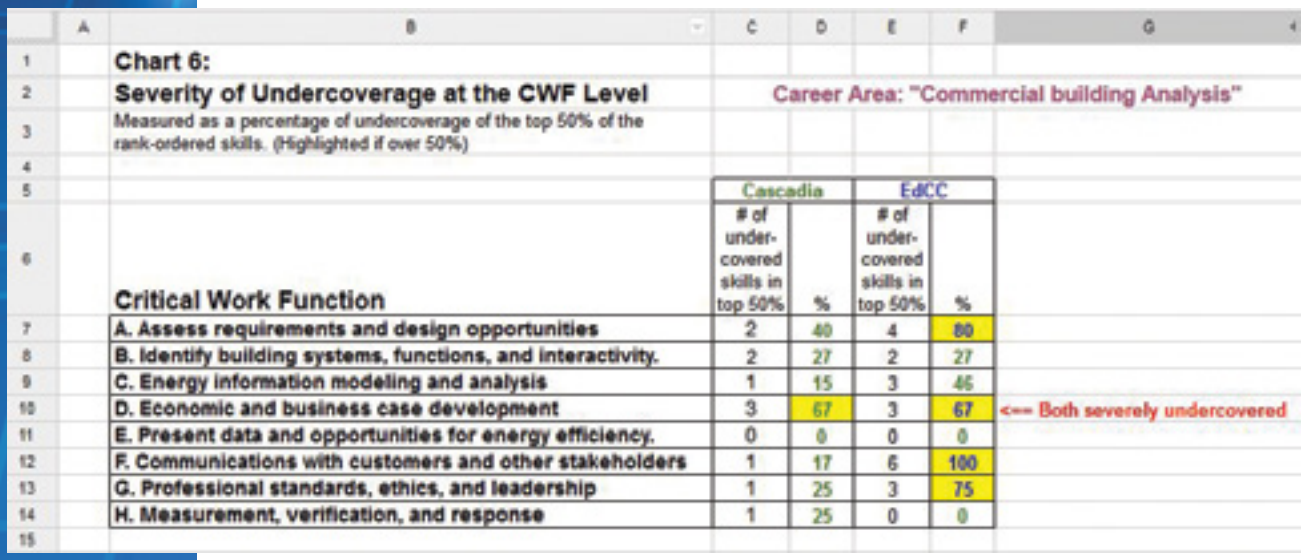


Chart 6:
Severity of Undercoverage at the CWF Level
Measured as a percentage of undercoverage of the top 50% of the rank-ordered skills. (Highlighted if over 50%)

Career Area: "Commercial building Analysis"

Critical Work Function	Cascadia # of under-covered skills in top 50%	Cascadia %	EdCC # of under-covered skills in top 50%	EdCC %	
A. Assess requirements and design opportunities	2	40	4	80	
B. Identify building systems, functions, and interactivity.	2	27	2	27	
C. Energy information modeling and analysis	1	15	3	46	
D. Economic and business case development	3	67	3	67	<== Both severely undercovered
E. Present data and opportunities for energy efficiency.	0	0	0	0	
F. Communications with customers and other stakeholders	1	17	6	100	
G. Professional standards, ethics, and leadership	1	25	3	75	
H. Measurement, verification, and response	1	25	0	0	

Figure 11. Portion of Chart 6 – Severity of Undercoverage for Two Energy Programs.

In Charts 2 and 3, the course-scoring sheets, the following courses were scored:

Edmonds:

ENRGY 100	Introduction to Energy Management (3 Credits)
ENRGY 102	Energy Basics (5 Credits)
ENRGY 105	Introduction to Sustainability (4 Credits)
ENRGY 120	Energy Efficiency: Design Construction and Retrofit (5 Credit)
ENRGY 130	Energy Assessment / Analysis: Residential (4 Credits)
ENRGY 135	Energy Accounting (3 Credits)
ENRGY 140	Energy Efficiency in Commercial Lighting (5 Credits)
ENRGY 145	Building Operations and Maintenance (5 Credits)
ENRGY 230	Energy Assessment & Analysis. II: Commercial (5 Credits)
ENRGY 245	Energy Management, Planning & Operations (4 Credits)
ENRGY 250	Energy Efficiency Program Planning & Design (3 Credits)
CIT 110	Energy Efficiency Technician (2 Credits)

Cascadia

ETSP 101	Introduction to Environmental Technologies and Sustainable Practice (5 Credits)
ETSP 102	Power Generation and Distribution (5 Credits)
ETSP 110	Conventional Energy Systems (5 Credits)
ETSP 120	Solar Energy Systems (5 Credits)
ETSP 180	AC/DC Lab (3 Credits)
ETSP 190	Documenting and Reporting Energy Use (3 Credits)
ETSP 201	Environmental Regulations. and Compliance (5 Credits)
ETSP 203	Energy Auditing and Analysis I (5 Credits)
ETSP 204	Carbon Footprint and Sustainability Analysis (5 Credits)
ETSP 205	Energy retrofit for Commercial Buildings (5 Credits)

Preparing and Using the Skill Profile Data

The WSU research team provided to the Edmonds/Cascadia team the industry focus-group data for each of the two career areas. This consists of the identified Critical Work Functions and the all the specific skills that support each CWF. In addition to the CWFs and specific skill lists, WSU provided the raw importance ranking scores that each focus group participant submitted. These are shown in Chart 1 for either of the career areas. (Refer to Figure 2, above.) The Edmonds/Cascadia investigative team used these importance rankings to develop an "Importance Factor" for each skill, relative to the other skills within the same CWF.

The derivation of the Importance Factor is also performed in Chart 1. Reading left to right, the original rank-order data for all focus group participants, and for each skill, is shown. For the raw importance ranking scores (shown as "Rankings from original data templates"), a lower number signifies greater importance for each respective skill. To be usable, these scores must be inverted so that a greater value signifies greater importance.

Once inverted, the importance scores are averaged, yielding Importance Factors. These are then normalized relative to the number of skills in each CWF. This latter normalization step is performed by dividing the average Importance Factor by the number of skills comprising each Critical Work Function. The resulting Normalized Importance Factors (NIFs) are convenient decimal values between 0 and 1. It is important to point out that, because of the rank-ordering method used, these normalized values CAN be used to compare importance WITHIN the respective CWF; they CANNOT, however, be used to make comparisons BETWEEN CWF's. In the chart, the right-most columns show the simple averages and the normalized importance scores.

Metrics: Coverage, Importance, Targets, Undercoverage, and Severity

The primary purpose of the Core Skills Analysis Tool is to measure the extent to which skills, recognized by industry as important, are taught in a particular energy management program. The Edmonds/Cascadia investigative team chose to call this value "Coverage." So, for each skill, there is a coverage score attributable to each course, and, when these are summed, the result is a coverage score for the program. Coverage values are developed for each program in Charts 2 and 3, and compared in Charts 4 and 5.

Coverage: As mentioned earlier, the instructor assigns the Coverage score for each skill. However, the Edmonds/Cascadia team recognized that the determination of coverage needed additional parameters to reduce subjectivity. Coverage was therefore developed as an arithmetic product of three other variables: "Exposure," "Maturity," and "Credit."

"Exposure" is a time-based variable that is scored on a range of 0 to 3:

0 = not exposed at all 1 = somewhat exposed
2 = moderately exposed 3 = extensively exposed

"Maturity" is a conceptual depth variable that, likewise, is scored on a range of 0 to 3:

0 = no depth 1 = introductory level
2 = intermediate level 3 = mastery level

"Credit" is determined for each course by the school, so it is not scored by the instructor. It serves as a background measure of the course's overall level of time commitment and expected effort, so it, too, is a weighting factor in the determination of Coverage. Hence:

Coverage = Exposure x Maturity x Credit

Normalized Importance Factor (NIF): The derivation of the NIF is described in section C above. It serves the following purposes:

- Allows the resulting Coverage values for each skill to be rank-ordered for importance within each CWF (shown in Chart 5). Skills are shown in descending order of importance.
- Allows the development of Scale Average Targets and Maximum Possible Targets. (Also shown in Chart 5.)

Targets: Two types of targets were developed and are displayed in Chart 5. They are standards against which each program's Coverage scores can be measured:

1. ***Scaled Averaged Targets (SCAs):*** SCAs (displayed as red bars) are proportional to the Normalized Importance Factor for each skill within each Critical Work Function. That is, the SCA is equal to the NIF times a scaling factor. This scaling factor is chosen uniquely for each CWF such that the average of an NIF times a scaling factor is approximately equal to the average of Edmonds' and Cascadia's Coverage scores combined, within the same CWF. Derived in this way, these SCAs are both proportional to the NIFs within any CWF, and they span ranges that correspond to the average coverage of both schools' programs, for a particular CWF. Because SCAs are proportional to the NIFs, they can be sorted in order of importance. Because they are scaled to the average of Actual Coverages, they are comparable. Accordingly, we believe they can be used as a general standard toward which the Actual Coverage scores (shown in dark blue and dark green for Edmonds and Cascadia, respectively) can aim. (Note: There is one red SCA bar per skill, and it applies to both schools.)

   The specific derivation of the Scaled Averaged Target is as follows. (Note that general steps correspond with detailed numbered steps shown in the online version of the spreadsheet. Ensure that all rows and columns are unhidden to reveal them.)
   - Within each CWF, bring in the NIFs from Chart 1, and give each absolute reference (colrow) so that, when later sorted according to the NIFs, they will stay associated with their skills and coverage scores. Do likewise with the Coverage scores from Charts 2 & 3. Copy the skill lists. (Refer to steps 1, 2, 3, 4 & 5)
   - For each CWF, calculate the average value of all the Coverage scores for both schools. Note this number. (Refer to step 7)
   - For each CWF, derive through iteration, a scaling factor unique for each CWF, which, when multiplied times the NIF for each skill, yields values that, when averaged, are approximately equal to the Coverage score average noted above. (Refer to steps 7 & 8)
   - Multiply the scaling factor for each CWF times the NIF for each skill. This gives the Scaled Averaged Target. (Refer to step 6)
   - Compare the skill scores against the Scaled Average Target. (Refer to Red bar graphs in Chart 5)

2. ***Maximum Possible Targets (MPTs):*** Also shown in Chart 5, an MPT target for a particular skill represents a "maximum possible coverage score" (MPCS) -- for every course. Such a maximized score consists of all scores being "3" for both Maturity and Exposure:

   MPCS for skill S_X = (Maturity score of 3) x (Exposure score of 3) x (# of credits)

For each skill, the Maximum Possible Target (MPT) is the sum of these maximized coverage scores, for all the courses, times the Normalized Importance Factor (NIF):

$$\text{MPT for skill } S_1 = (\text{MPCS for course}_1 + \text{MPCS for course}_2 \ldots + \text{MPCS for course}_X) \times \text{NIF}$$

$$\text{MPT for skill } S_2 = (\text{MPCS for course}_1 + \text{MPCS for course}_2 \ldots + \text{MPCS for course}_X) \times \text{NIF}$$

The MPT represents "extensive exposure at a mastery level", and would convey the ability to perform at a high level of professional competence on any of the industry-defined skills. Notice that there are two MPT bars per skill. The light blue bars pertain to Edmonds and light green bars pertain to Cascadia. The dark blue and dark green bars represent Edmonds' and Cascadia's actual Coverage, respectively. Thus, the MPT/Actual comparison is another measure (albeit humbling) of what could be taught.

Undercoverage: Also displayed in Chart 5, this is a relationship, for a skill, between the Actual Coverage of the skill and the Scaled Average Target. When Actual Coverage is less than 75% of the Scaled Average Target, the CSAT highlights the cell in yellow for that skill and participant. Though the cut-off percentage is arbitrary, it shows which skills are the covered least. While Chart 5 is the working sheet for for the identification of undercovered skills, these results have been summarized in 2 tables (one for each Career Area) in order to save space in this report. The summary tables are titled "Summary of Chart 5: Undercovered Core Skills."

Severity of Undercoverage at the CWF Level: This value, developed and displayed in Chart 6, allows for an assessment of skill coverage at the level of a CWF. And, it acknowledges that, within a given CWF, not all skills are equally important. When the most important skills are undercovered, this could be a significant program deficiency. Expressed as a percentage, Severity gives a simple measure of the extent to which the most important skills within any CWF are undercovered. Specifically:

Severity = percentage of skills within top-half of the rank-ordered list that are undercovered.
And, when this percentage exceeds 50%, it is highlighted.

Derivation of this value for a given CWF is as follows: From Chart 5, the total number of skills in the CWF's rank-ordered list is determined. Fifty-percent of this number represents the half of the list of topmost importance and is the base of the Severity percentage. From Chart 5, the number of undercovered skills for the CWF that reside in the upper 50% of the rank-ordered list is determined. This number, divided by the previously derived number, yields the Severity value expressed as a decimal. It is converted to a percentage value. Where this percentage is greater than 50%, the CSAT will show it highlighted.

Scoring the Courses

As previously mentioned, courses are scored for Maturity and Exposure by the instructors who teach them. To insure reliable results, it is important that the following considerations be operationalized during the scoring process:

1. Instructors should be comfortable with this scoring effort and with any subsequent interpretation of results and suggestions for course revisions. Fully explaining the purpose of the exercise, and how the results will be used, will increase participation. (And, it may even spur constructive discussion at a level of unprecedented detail.) If the assessment is being conducted within one energy program, it should be explained that results will be used to consider adding new industry-defined skills to courses, or reprioritizing the skills that are already taught, based on the importance rankings of the industry-defined skills. If, by contrast, the exercise is conducted between more than one energy program, instructors may need to be reassured that any identification of duplication between programs will not necessarily lead to immediate dislocations, but, rather, should be seen as part of a longer-term process to increase differentiation and specialization between the program partners.

2. Instructors need to understand the context within which a particular skill is being scored. The focus group has identified particular skills as serving their respective Critical Work Functions. So, when scoring a skill for the extent to which it is actually taught, it is important to consider this within the context of the particular CWF. For example, within the Commercial Building Analyst CSAT, spreadsheet skills (C2) are found within the context of CWF 3, "Energy information modeling and analysis". It would be erroneous to assume that spreadsheet skills, taught within the context of, say, preparing business proposals, would satisfy the needs of energy modeling in this CWF. Conversely, there may be a taught skill that, upon reflection, can indeed support the needs of another CWFs. The basic principle here is that the scores assigned to a taught skill must reasonably reflect the skill's applicability to the CWF that it is purported to serve. Such a reasoned approach must be exercised for each score. Accordingly, adequate explanation of this principle must be conveyed to the scoring instructors.

3. Similarly, it is possible that a skill may appear more than once, listed under different Critical Work Functions. For example, within the Commercial Building Analyst CSAT, the skills pertaining to "industry codes" (A1) and "technical codes" (G1) may on the surface appear to be the same, but when viewed through the lense of their respective CWFs ("A – Assess requirements and design opportunities" versus "G– Professional standards, ethics, and leadership"), it is apparent that they are very different. Again, explaining to instructors the need to reason though these categories is important to maintaining the integrity of the scoring exercise.

4. The investigative team found that a group meeting with the instructors prior to scoring was an effective way to convey the subtleties of this categorical reasoning. With the give and take of questions, answers, and short discussions focused on examples, the distinctions become clear.

Interpreting Results – General Caveats and Limitations

1. **Interpretation**: Whether performing an assessment on a single program, or multiple programs, the following questions are fundamental to the inquiry:

    - Which skills are under-covered, relative to industry needs? The CSAT gives a preliminary indication of these in Chart 5. If a skill's Coverage score is lower than 75% of the Scaled Average Target, they are shown highlighted in yellow, as shown in Figure 10, above.

    - Of the skills that are shown as not being adequately covered (highlighted in Chart 5), are they of high importance? This is readily determined by the position of any highlighted skills. Within each Critical Work Function, skills are ranked from most important at the top, to less important toward the bottom. So, if highlighted skills are found toward the top of this rank-ordered list, they are skills of high importance that are under-covered. A measure of such undercoverage of important skills -- "Severity" -- is described above. A specific example of "severe" undercoverage is shown in Chart 5, above. There, the skill ranked highest in importance, "A8 -- Foundational Building Systems Knowledge", is shown as under-covered by both EdCC's and Cascadia's programs.

    - For any CWFs that show "severe undercoverage" (shown highlighted in Chart 6), are these CWFs ranked highly in importance in Figures 3 & 4, above? This takes the Severity assessment shown in Chart 6 one step farther by determining if there are highly important CWFs whose highly important skills are undercovered. If so, this represents the most significant lack of coverage for a program. One can make this determination directly by checking to see if any of the highlighted CWFs in Chart 6 are ranked as important in figure 3 or 4. For example, in the career area "Energy Program/Project Management", Chart 6 (below) identifies a CWF "Manage Budgets" in which, for both schools' programs, more than 50% of its most important skills are undercovered. This "severe" undercoverage has been indicated in red notation. However, looking further, this CWF is found, in Figure 4 above, to be ranked quite high in importance. That is, the skills contributing to the ability to "Manage Budgets" is not taught sufficiently by either program, yet "Manage Budgets" is considered to be one of the most important work functions in this career area.

	A	B	C	D	E	F	G
1		**Chart 6:**					
2		**Severity of Undercoverage at the CWF Level**			Career Area: "Commercial building Analysis"		
3		Measured as a percentage of undercoverage of the top 50% of the rank-ordered skills. (Highlighted if over 50%)					
4							
5			Cascadia		EdCC		
6		**Critical Work Function**	# of under-covered skills in top 50%	%	# of under-covered skills in top 50%	%	
7		**A. Assess requirements and design opportunities**	2	40	4	80	
8		**B. Identify building systems, functions, and interactivity.**	2	27	2	27	
9		**C. Energy information modeling and analysis**	1	15	3	46	
10		**D. Economic and business case development**	3	67	3	67	<-- Both severely undercovered
11		**E. Present data and opportunities for energy efficiency.**	0	0	0	0	
12		**F. Communications with customers and other stakeholders**	1	17	6	100	
13		**G. Professional standards, ethics, and leadership**	1	25	3	75	
14		**H. Measurement, verification, and response**	1	25	0	0	
15							

Figure 12. Portion of Chart 6 -- Severity of Undercoverage for Two Energy Programs.

2. **Caveats and Limitations:** Interpretation requires that one to be able to draw conclusion such as, "We appear to be doing well here," or "We need improvement there," or "This deficiency is worse than that deficiency." The CSAT makes such comparisons possible because the industry-defined skills are rank-ordered. A few caveats are important to keep in mind:
   - All of the skills identified by the focus groups were framed as "necessary" or "important" to the CWF that they support, but subsequent rank-ordering indicated that some were found to be more important than others. Thus, as the course-scoring data is interpreted, one should never assume that, since the skill is lower-ranked in importance, that any deficiency in coverage is inconsequential -- that the skill simply does not need to be taught. Every identified skill was deemed to be necessary to the CWF it supports.
   - Standard deviation - In ranking the skills for each CWF, agreement varied among the industry subject matter experts as shown by Standard Deviation on the charts in the appendices. Checking these standard deviations can yield further information in terms of priorities for program/course development. Those CWF skills rankings with lower standard deviation, for example, indicate a more accurate reflection of priority ranking among the group.
   - Individual instructor scoring can be subjective and can yield results that are somewhat skewed. To avoid this, project researchers advise instructors to group score (even between two institutions), so that definitions can be agreed upon within the group as they are scoring.

Evaluation of Results

Within Each College

1. **Observations:**
   Edmonds CC: The results of this investigation appeared to reveal significant undercoverage in three Critical Work Functions:
   For the Energy Program/Project Management career area:
   - Manage people
   - Develop and implement proposals

   For the Commercial Building Analyst career area:
   - Communications with customers and other stakeholders

   One possible explanation for these particular clusters of undercoverage is the following: The undercovered skills appear to align with conventional management skills. Two management courses are required for the degree, but were not scored because they are taught through the Business Division. The Edmonds team believes that, in retrospect, this was an oversight. These classes, MGMT 214 "Principles of Management" and MGMT 270 "Project Management I: Project Scope/Requirements", if scored, would likely improve the coverage scores for these skills. The lesson here is to be sure to score all relevant, required courses. The Edmonds team hopes to pursue this omission in the future.

2. **Implications for Career Pathway Development and Continuous Improvement**
   Edmonds CC: This project has yielded the following changes in the Energy Management (EM) program at Edmonds Community College. Specifics are described below:
   - With a better understanding of how important the commercial sector is and how well students need to be versed in this area, Edmonds CC split the energy assessment course into Energy Assessment and Analysis I (residential) and Energy Assessment and Analysis II (commercial).
   - Development of an advanced lighting class, ENRGY 240, to course offerings in response to the complexity of the subject, especially in commercial buildings.
   - Realignment of our certificate program with industry expectations, i.e. better alignment of certificates to jobs (career pathway).
   - Eliminated the Energy Accounting Specialist certificate.
   - Bolstered other certificates with added classes to increase skill level attained.
   - Renamed certificates to align with industry terminology.
   - Responding to identified skills (EPPM skill D8 and CCB skills H3 & H4), the EM program acquired a robust inventory of auditing and test equipment for assessing building performance. This includes general tools, infrared cameras, blower doors, wireless data loggers, and analysis software.
   - With Communication as a top skill among many different CWFs, it is important for students to be able to communicate to a number of different audiences and faculty have adjusted work assignments in the program for them to practice doing just that.

- The Key Activities identified by industry through the focus group work help faculty better understand how to organize activities using the skills/competencies to mirror industry work.
- Industry has emphasized how important the identified skills are for the workforce and our future. Edmonds CC is currently modifying the program to offer our Energy Management Core courses online (the first 4 courses in the program), so that they can be available to a wider audience. Edmonds CC expects to offer these fall 2014.
- Development of an annual 1 or 2 credit "mini-course" on a special industry-relevant topic, taught over two successive Saturdays, and advertised at neighboring institutions. So far, offerings have included Portfolio Manager, Energy Code Updates, and HVAC Controls Fundamentals.
- Continuing to analyze the Core Skills Analysis Tool (CSAT) data, Edmonds CC expects to further improve its own career pathway, in particular looking at program undercoverage against industry targets.
- Use of the CSAT to analyze other skills related to relevant occupations, such as the skills provided by the Department of Energy's Better Buildings Workforce Initiative.

Cascadia CC: This project has yielded the following changes in the Environmental Technologies and Sustainable Practices (ETSP) program and in other areas of Cascadia Community College. Specifics are described below:

- Development of a new Certificate, Community Energy Specialist.
- Development of a technology-focused Math in Society course (with technical application).
- Development of a communications course, Communication in Organizations.
- Development/redevelopment of four courses in the ETSP program. They are:
  - ETSP 110, Conventional Energy Systems
  - ETSP 206, Solar PV System Design and Site Assessment
  - ETSP 208, Large-Scale Solar Energy Systems
  - ETSP 210, Community Energy Systems
- Redevelopment of the Physics 111, Physics of Sustainable Energy, syllabus.
- Exploration of Green Informatics degree and/or certificate.
- Institution-wide implementation for all courses offered to have a Sustainability designation.
- Development of an option of ETSP in the water quality arena
- Continue to rethink some of the Course Outcomes Guides (COGs), i.e., match existing COGs against these outcomes.
- As the career lattice is developed, rethink courses to inactive because students would be better served taking this course at another location.
- Take the results of the CSAT analysis to the Student Learning Committee.
- Review these skills with the programs Technical Advisory Committee.

Between the Partner Colleges

1. Implications for Growing a Career Lattice: Student Choice and Advising

The use of the CSAT is helping to elucidate differences and similarities, leading to the building of a Career Lattice between Edmonds CC and Cascadia CC. Building career lattices between institutions acknowledges the broad scope and complexity of the energy field. Working together to develop complementary pathways that teach industry-defined requisite skill sets helps deliver more options for the workforce and students alike. Making these pathways and lattices transparent in a collaborative manner eliminates the need for unnecessary course/program duplication, which is especially important in challenging economic times.

The Energy Education/Career Lattices can be used as tools to identify energy-related educational programs and alternatives and synergies between them and creates a framework for information sharing between educational institutions, both maximizing opportunities for students and streamlining information flow for students, faculty, and administrators alike. In doing so, the colleges work to ease the entrance of high school students into programs, improve the transferability between programs and enhance the articulation to 4-year institutions and employment. Ultimately the lattice helps to provide a clear pathway for students to pursue their educational and career goals, based upon their interests and abilities.

Beyond the Partner Colleges: Use of the CSAT and Data by Others

1. **Use by Other Colleges:**
   While the CSAT itself has not been used, to date, by colleges besides Edmonds CC and Cascadia CC, the skills profile data have proved valuable in the development of new courses. Using the data from the ranked skills and skill checklists, skills can be easily included in new curriculum. Six educators (outside of the energy programs at Edmonds CC and Cascadia CC) participated in developing curriculum based on project research that show a range of application. Courses developed are as follows:
   - Alternate Energy Sources for Residential Construction, Green River Community College
   - Basic Team Communication Skills for Project Management, Shoreline Community College
   - Electronics for Renewable Energy Systems, Edmonds Community College
   - Introduction to Foremanship for Craft Workers, Northwest Washington Electrical Industry Joint Apprenticeship & Training Committee
   - Advanced PV Design, Shoreline Community College
   - Living Building Renovations through Energy Management

2. **Use of the Data by Industry:**
   The same tool could be adapted for use by industry trainers, who also need to adjust and enhance internal training programs. Generating a model to support industry's use of this tool will help ensure that the skill profiles will be the basis for program changes and improvements, which in turn provides a common platform for knowledge and skill development, and improved alignment between industry and college programs. Several industry partners have already expressed an interest in implementing the CSAT.

Conclusion

A central and pervasive finding that emerged through our focus group data and profiling process is the increased emphasis and importance reported by energy management employees of a growing need for solid data management/analysis, information technology, and general communications skills. Technology innovation and development has accelerated the implementation of advanced systems and devices designed to promote greater energy efficiency, and these new systems, devices and applications have elevated the expectations and requirements of employers concerning the skills required of energy project managers and building analysts. Just as the Smart Grid is adding new layers of technology-driven capabilities to the electrical grid, energy project managers and commercial building analysts described how their ability to collect, manage, analyze and make sense of ever-larger amounts of data has become increasingly important. This responsibility has meant building an interdisciplinary approach to developing new skills and knowledge of information technology systems, software and applications which are used to organize, manage and analyze data, and as a conduit for communicating the meaning and utility of these data across occupations, departments and organizations. Technology enhancements have also enabled data and information exchange that is dynamic and not static, meaning that the intensity and methods for communicating energy data and information have increased, placing new demands on the ability of energy professionals to know and apply advanced communications systems, software and applications.

Another finding relates to the importance of project/program management as a "wrap-around" skill set for any energy management occupation. The two occupation areas selected by industry and labor correspond to two primary business processes within professional service firms which engage in the energy management and energy efficiency services industry. These are commercial building analysis and energy program and project management. The commercial building analysis occupations represent the business development process and the more general project/program management occupation represent the management of the service delivery process. These two processes overlap or coincide at the proposal creation Critical Work Function that they both hold in common. In short, commercial building analysis skills are required to identify if an opportunity exists and to specify credibly and reliably what specific improvement options might be committed in a contract proposal. The program/project management function then engages and manages the proposal generation and delivery of required services to effectively implement the services and other commitments that constitute the successful fulfillment of the contract. Maintaining this business context is crucial from an industry and labor perspective since it contextualizes the skills and is the motivation for the business operations. This business process contextualization is also very important in curriculum development efforts since it provides a relevant framework for contextualizing the skills and competencies within courses.

While the two processes are both critical to successful business operations in energy management firms, the program/project management skills and competencies are more general and have application in a wide variety of energy management firms and even other industries. This general applicability of project and program management skills and competencies, particularly in conjunction with technical assessment capabilities (commercial building analysis is an example) potentially provides an opportunity for educational institutions to leverage program/project management training in combination with other technical analysis training to diversify the career opportunities available within the community college professional technical education system. Leveraging this capability would require additional focus group research targeting different technical occupations and creating an interdisciplinary approach to preparing for these occupations.

An innovation developed and implemented during this research extended the focus group approach previously used in other applications (DACUMS, skills panels, skill standards, etc.) to include rank ordering skills and competencies in terms of importance. The importance ranking for the skills and competencies were collected for each individual participant and this information was provided for dissemination to curriculum development faculty. This innovation provided two important benefits to the curriculum development process. First, the industry-endorsed importance ranking is valuable information for faculty making decisions regarding which skills and competencies to include or emphasize in curriculum development efforts and was used in the development of the Core Skills Analysis Tool. Second, since the skills importance ranking are collected on an individual participant basis, the variance is a measure of agreement between respondents indicating how consistent the importance of a particular skill is across different industry representatives. Both pieces of information are available for all skills and competencies and are important considerations when designing new courses or modifying existing curriculum. For example, the most important skills and competencies might be incorporated into the introductory project management course while other less critically important but none the less valuable skills are emphasized in a following, perhaps elective, course. Additionally, in modifying existing courses, the skills and competencies results can be used to make decisions regarding incremental additions of topics to an existing course. This occurred at Cascadia Community College where market analysis skills and strategic thinking skills were incorporated into the existing project management course based on the importance rankings from the energy program/project management focus group.

Lastly, the research team found great value in the condensed skills profile process in an emergent and rapidly changing industry, energy management. In the past, setting up new programs might involve the use of such methods as skill standards, DACUM, and job task analysis to ascertain what should be at the heart of the program or course outcomes. However, these methods, can be very costly to produce, difficult to revise and sometimes too detailed for the course/program development process. Project researchers observed at the Pre-Summit Educators Institute that faculty were able to readily and quickly start looking at their courses/programs to see whether or not they were well aligned with the industry-defined core competencies and skills, and moreover, with the ranking of these core skills, it was also possible to use a more rational approach to making choices as to which skills to include and how much time to spend presenting them. The next step in this work will be to use the CSAT for developing training within industry.

To conclude, why is energy education so important? Building operations make up the bulk of our energy consumed in the U.S., and thus carbon output with the combustion of fossil fuels making up the majority of our energy production. As the biggest slice of the consumption pie, building operations also provides the biggest opportunity in terms of reductions and efficiencies. The institutions involved in this project are working to provide industry-relevant programs that graduate students who will be working directly with building energy efficiency, management, and conservation. This work has the direct and tangible effect of decreasing carbon emissions, which scientists agree is essential to mitigating climate change effects.

Appendix A: Skill Rankings –
Energy Project/Program Management

After the focus group participants identified which skills were associated with each critical work function, they rank ordered the skills in priority order as listed in A-1 through A-8.

The charts below provide additional detail by showing the average rank of each skill as scored by the focus group participants. The standard deviation bar shows the amount of variability in the ranking given by the group. The higher the standard deviation bar, the less uniformity in the ranking of that skill. This level of detail may be of use and interest to trainers and teachers who are developing curriculum based on this profile. These charts enable you to see how important the group deemed each skill to be relative to the other skills associated with the critical work function.

Figure A-1. Ranking of Skills: Manage People

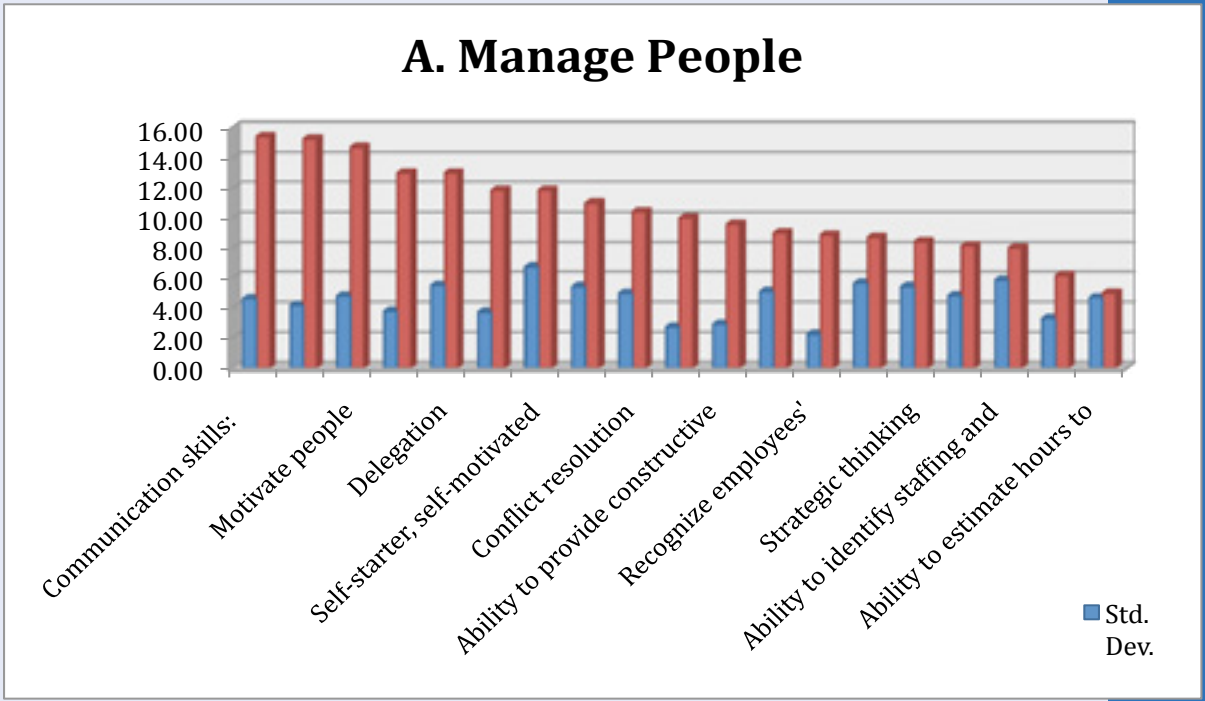


Figure A-2. Ranking of Skills: Manage Budgets

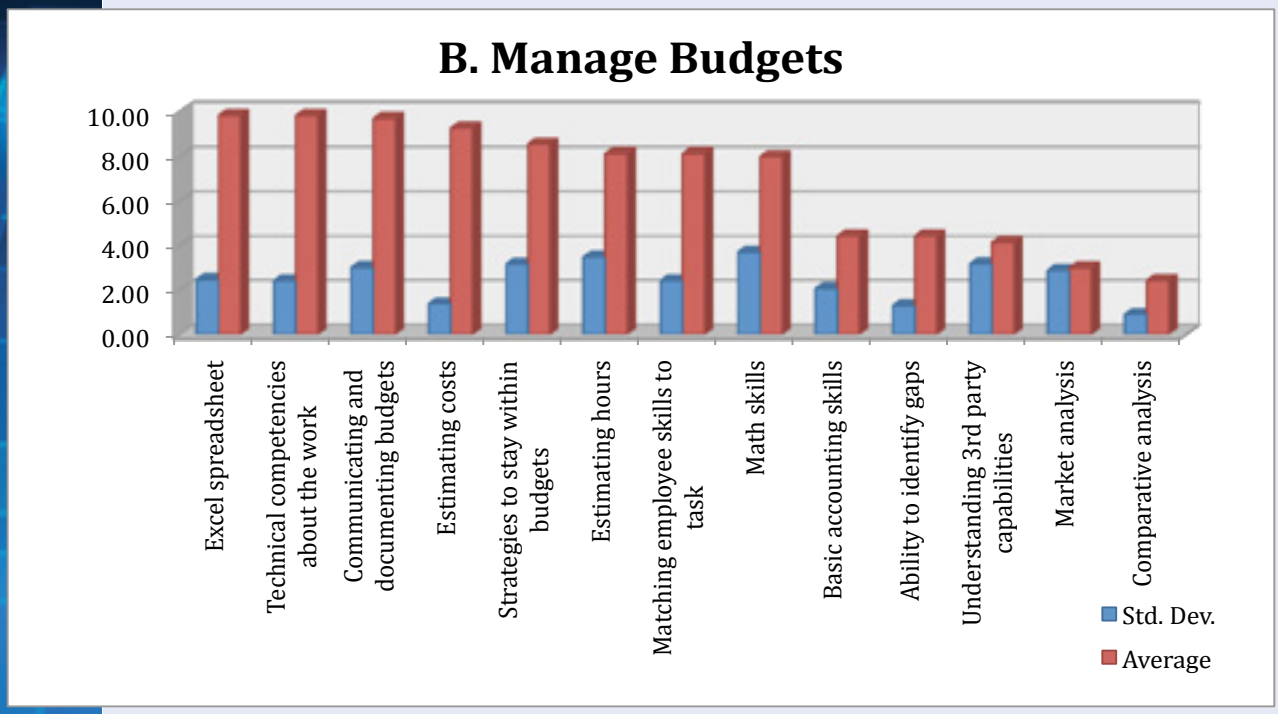


Figure A-3. Ranking of Skills: Develop and Implement Proposals

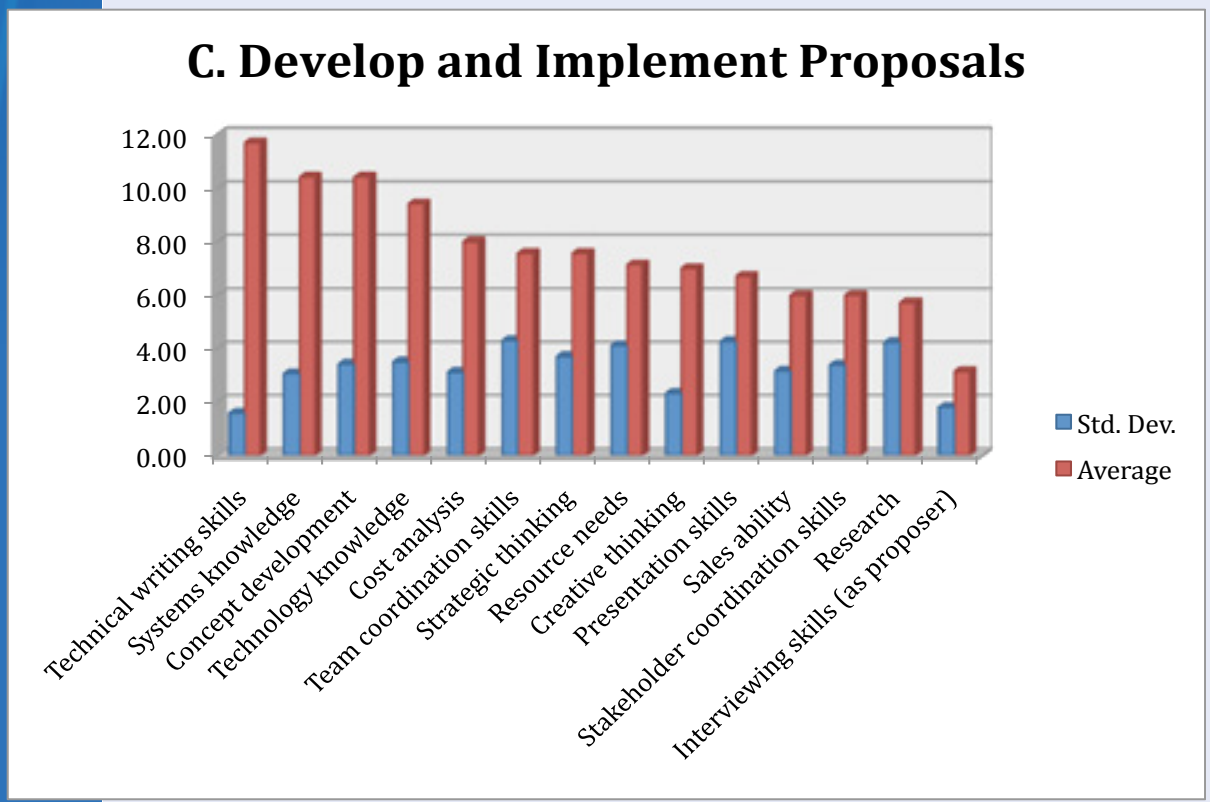


Figure A-4. Ranking of Skills: Educate and Train

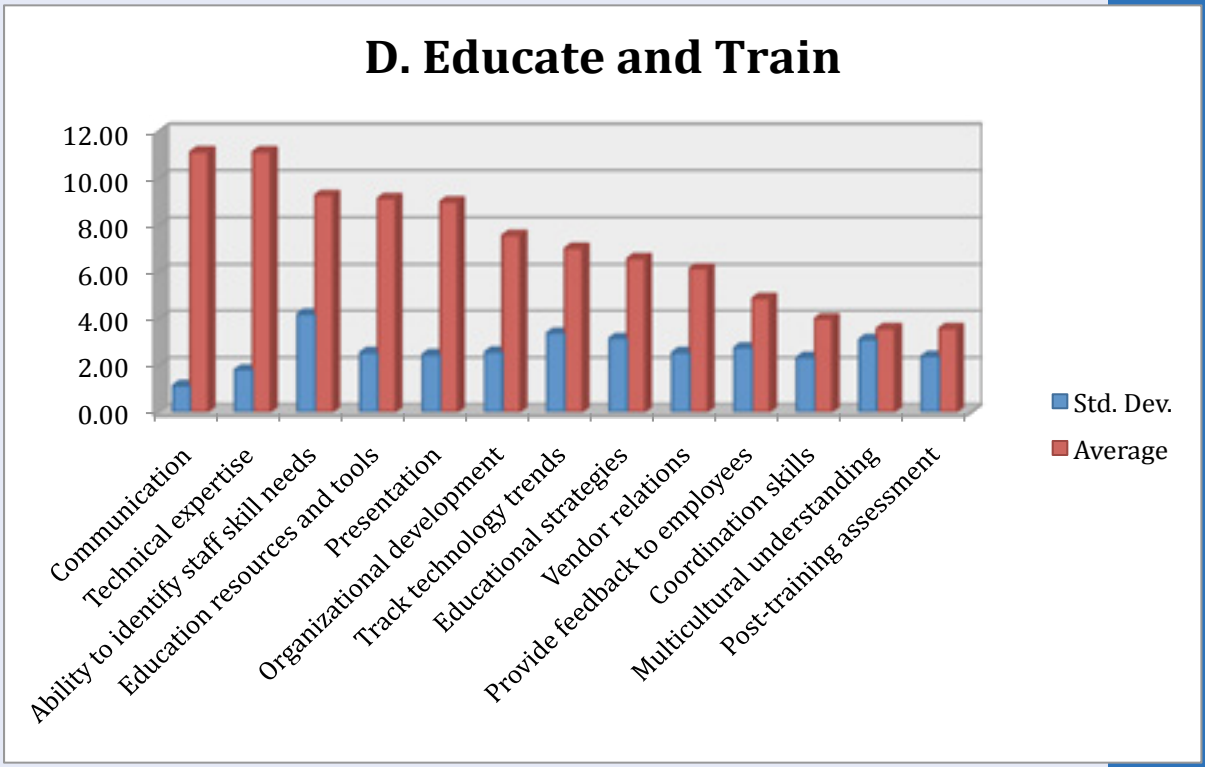


Figure A-5. Research, Analyze, and Assess

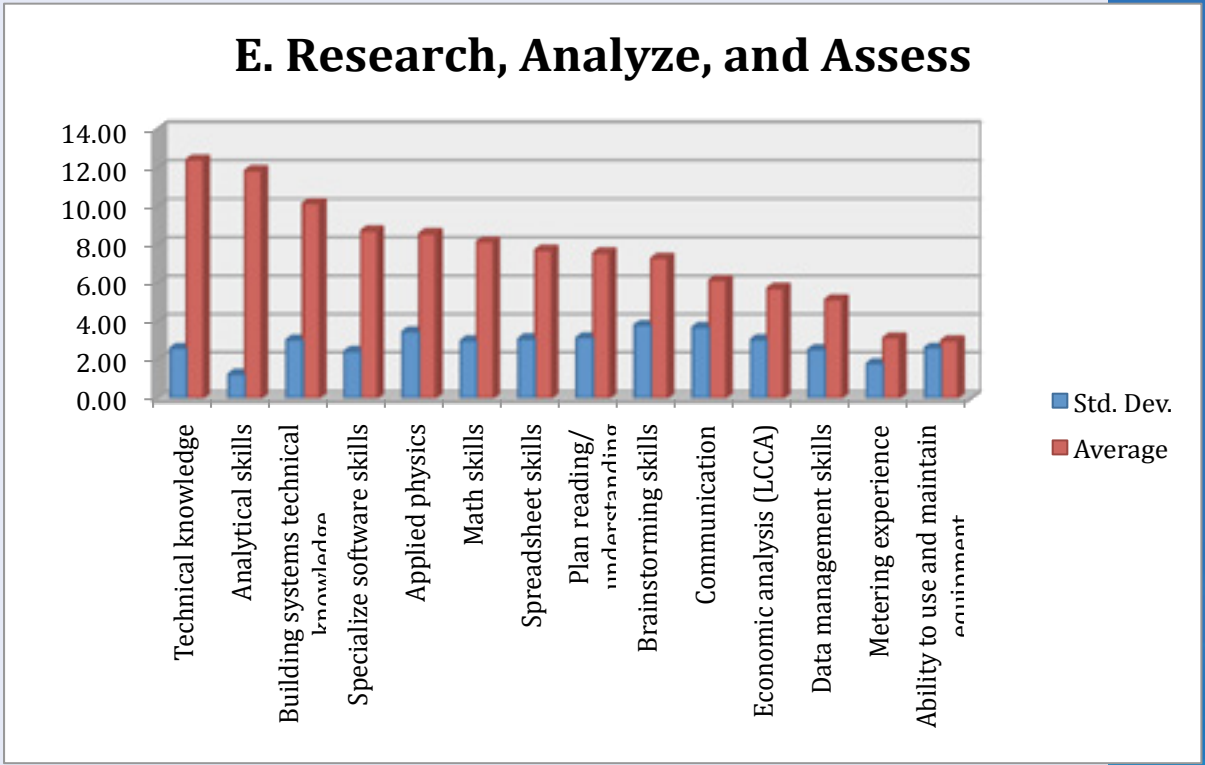


Figure A-6. Ranking of Skills: Coordinate External Funding and Incentives

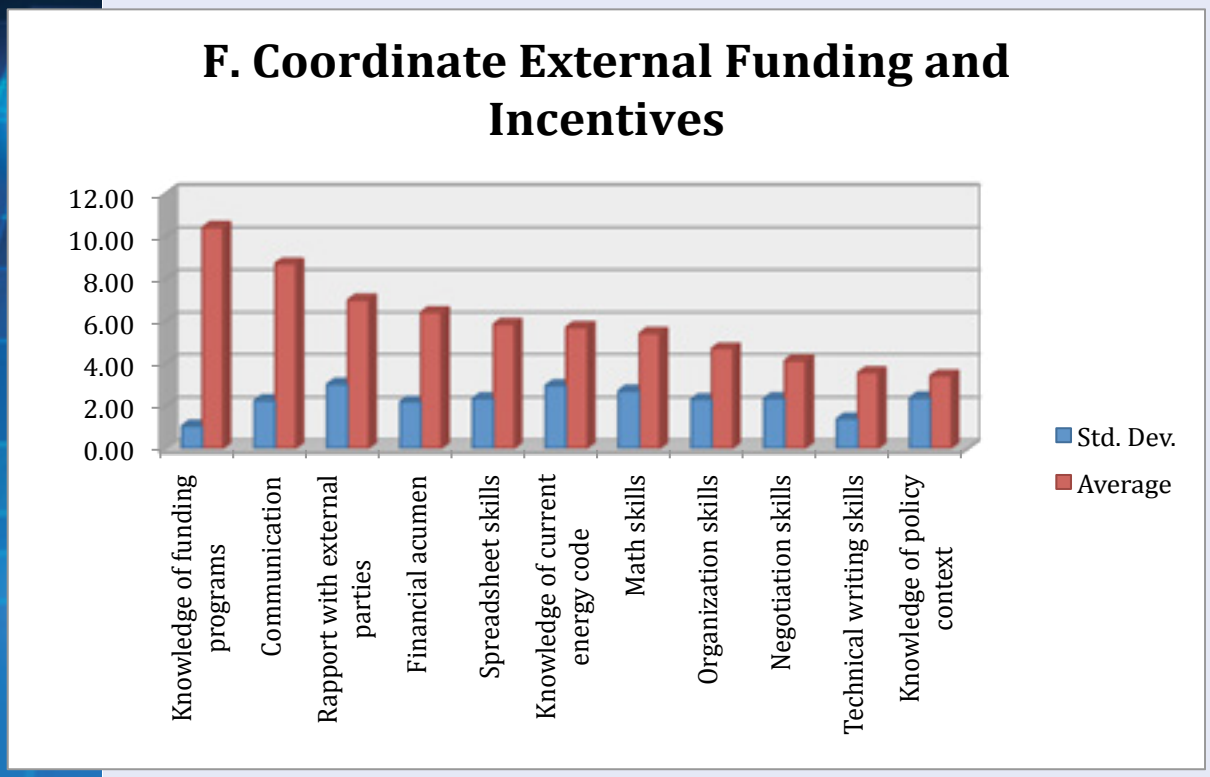


Figure A-7. Ranking of Skills: Communicate

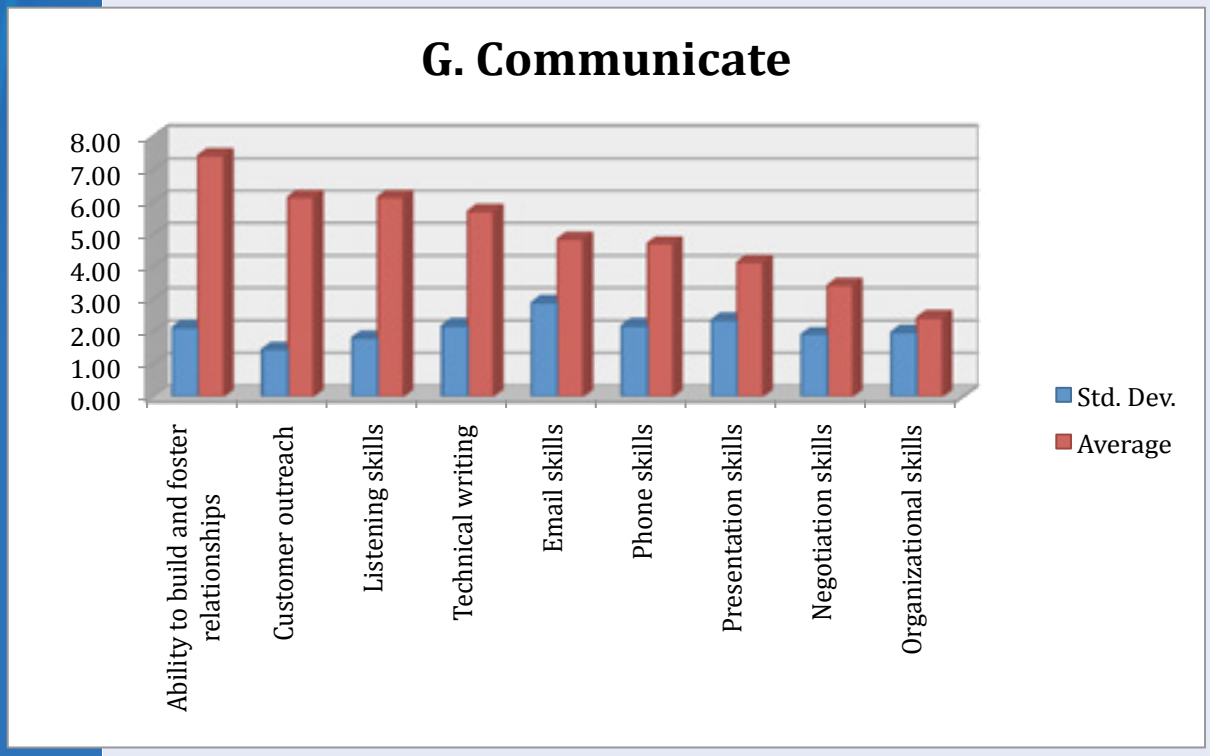
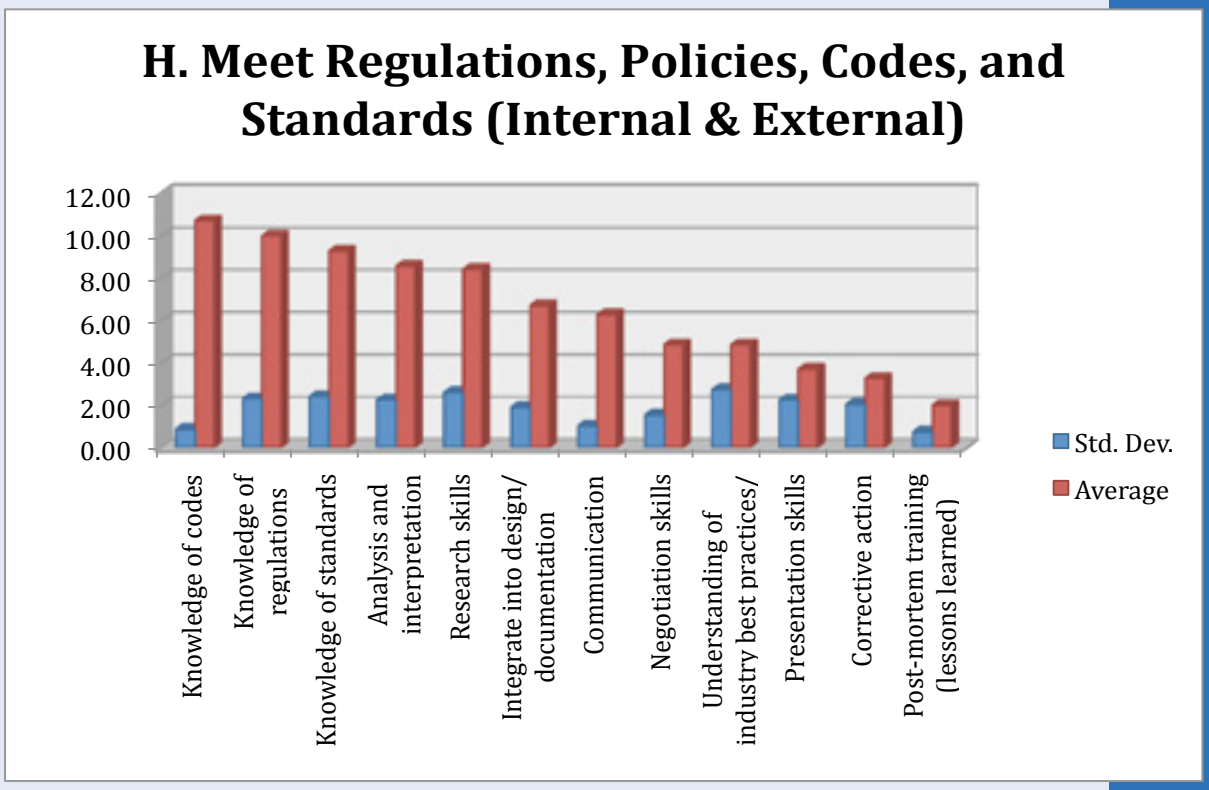


Figure A-8. Ranking of Skills: Meet Regulations, Policies, Codes, and Standards (Internal & External)



Appendix B: Skill Rankings – Commercial Building Energy Analysis

After the focus group participants identified which skills were associated with each critical work function, they rank ordered the skills in priority order as listed in Figures B-1 through B-8.

The charts below provide additional detail by showing the average rank of each skill as scored by the focus group participants. The standard deviation bar shows the amount of variability in the ranking given by the group. The higher the standard deviation bar, the less uniformity in the ranking of that skill. This level of detail may be of use and interest to trainers and teachers who are developing curriculum based on this profile. These charts enable you to see how important the group deemed each skill to be relative to the other skills associated with the critical work function.

Figure B-1. Ranking of Skills: Assess Requirements and Design Opportunities

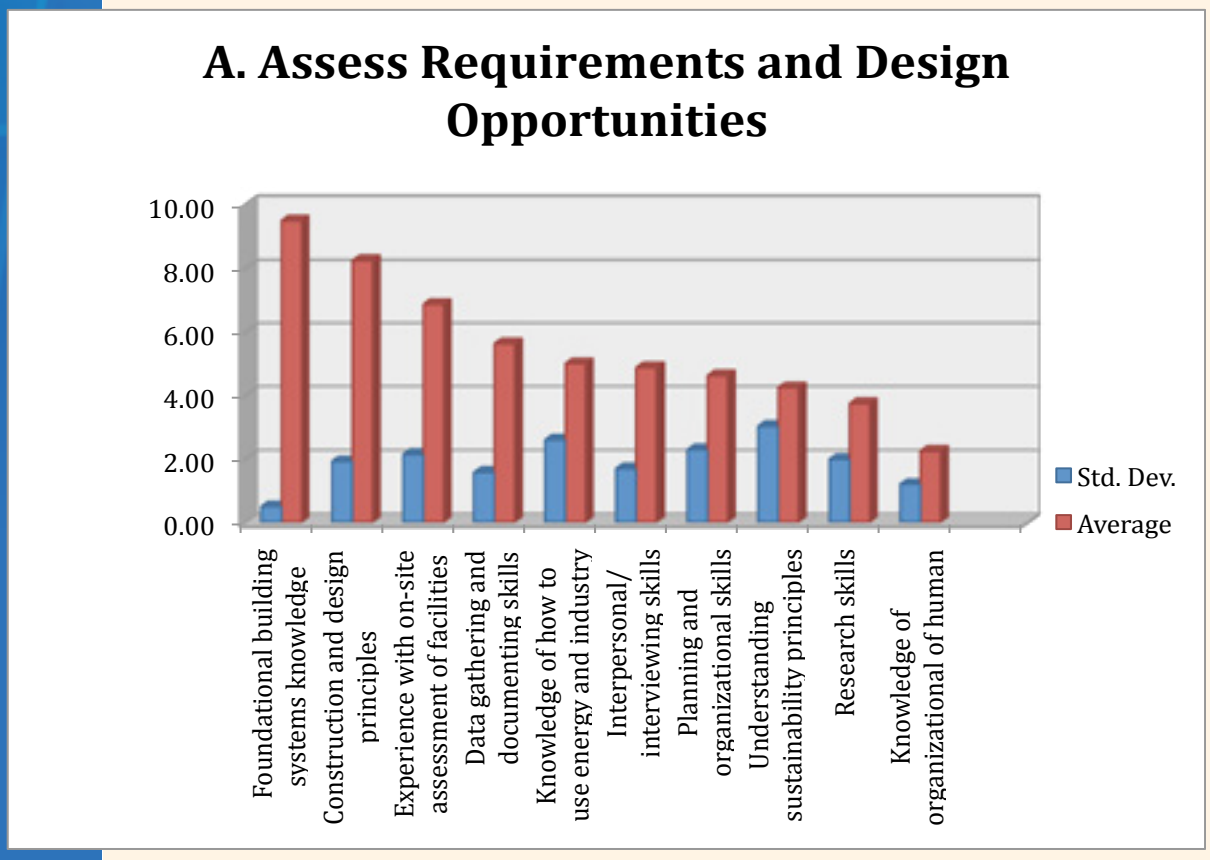


Figure B-2. Ranking of Skills: Identify Building Systems, Functions, and Interactivity

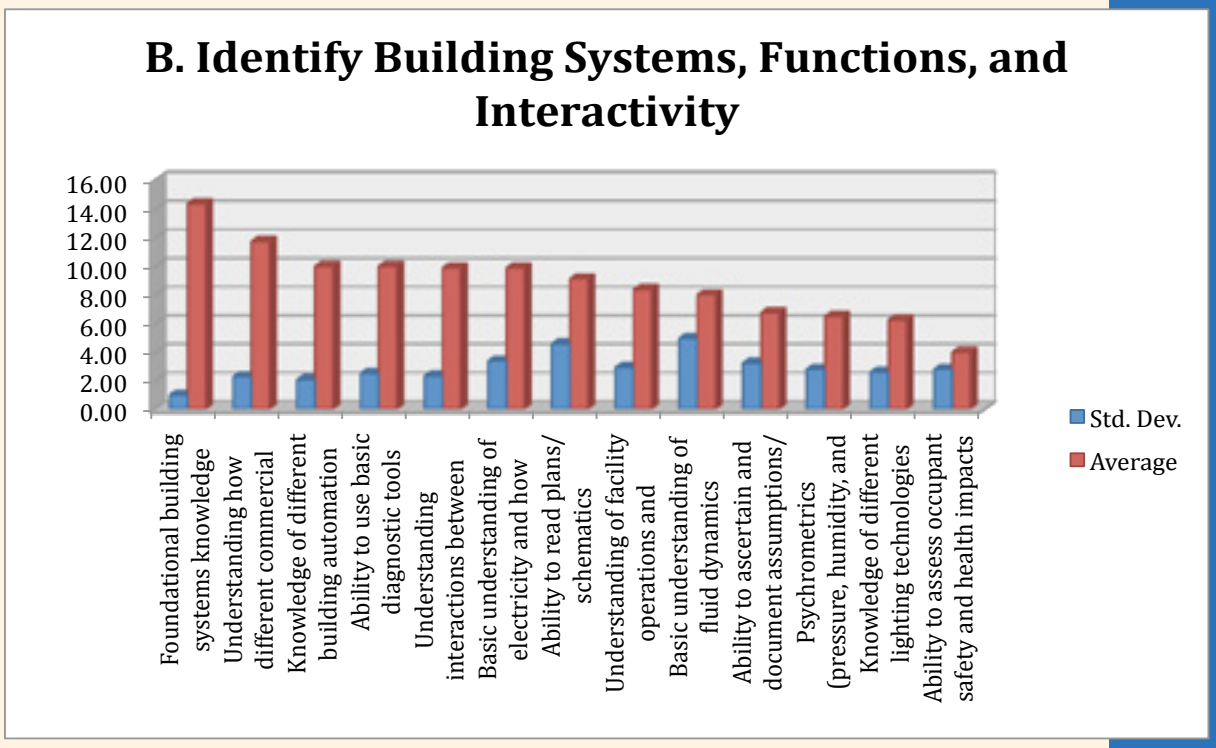


Figure B-3. Ranking of Skills: Energy Information Modeling and Analysis

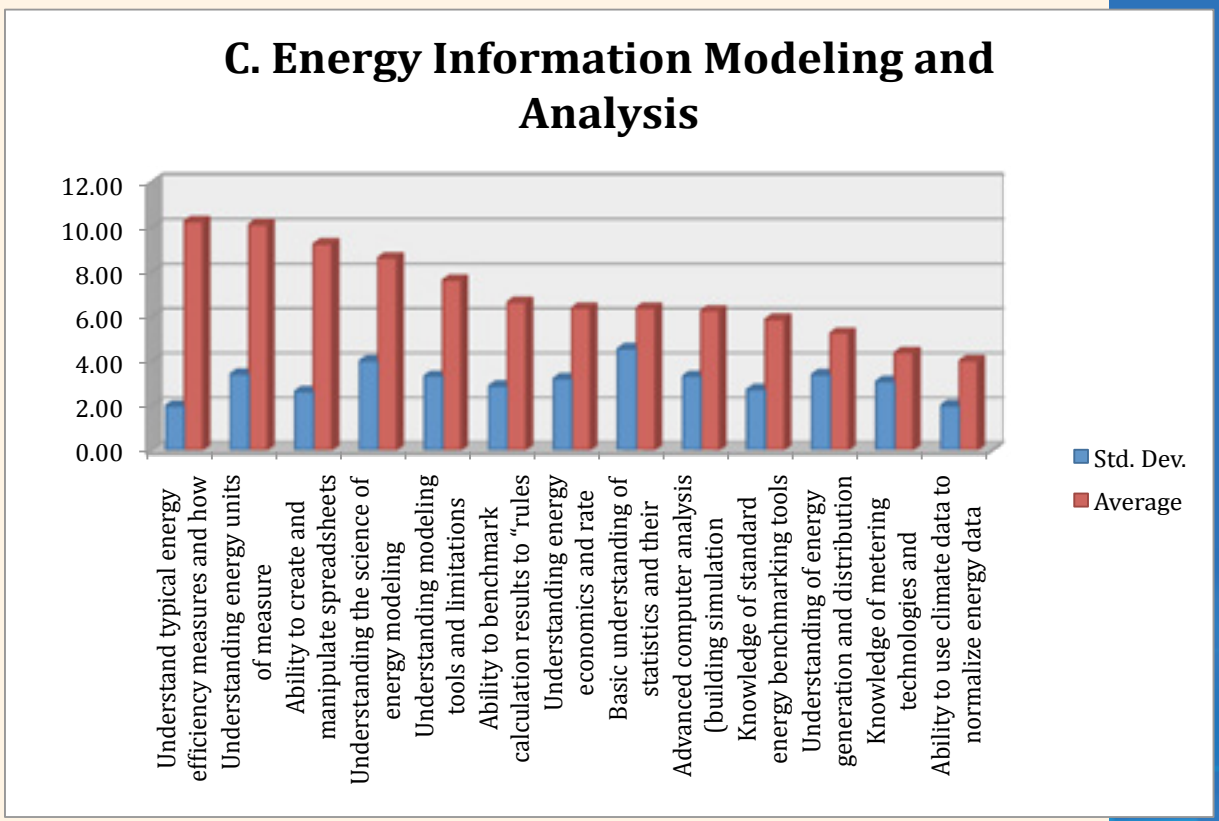


Figure B-4. Ranking of Skills: Economic and Business Case Development

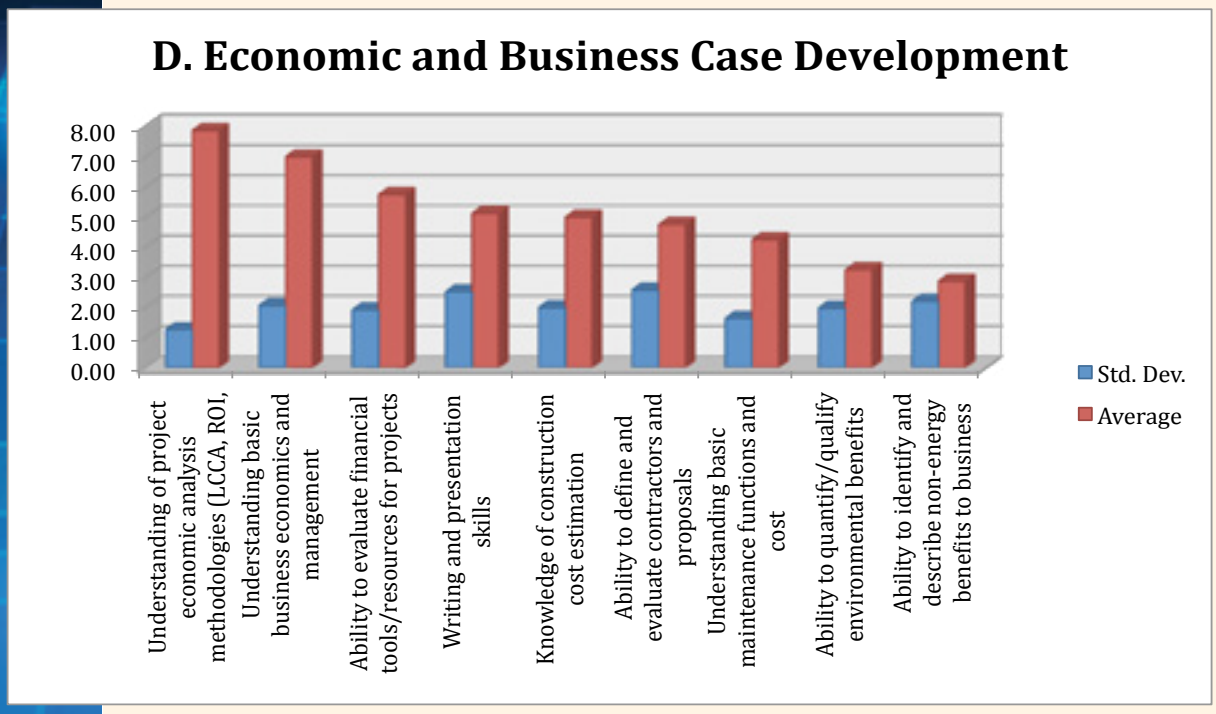


Figure B-5. Ranking of Skills: Present Data and Opportunities for Energy Efficiency

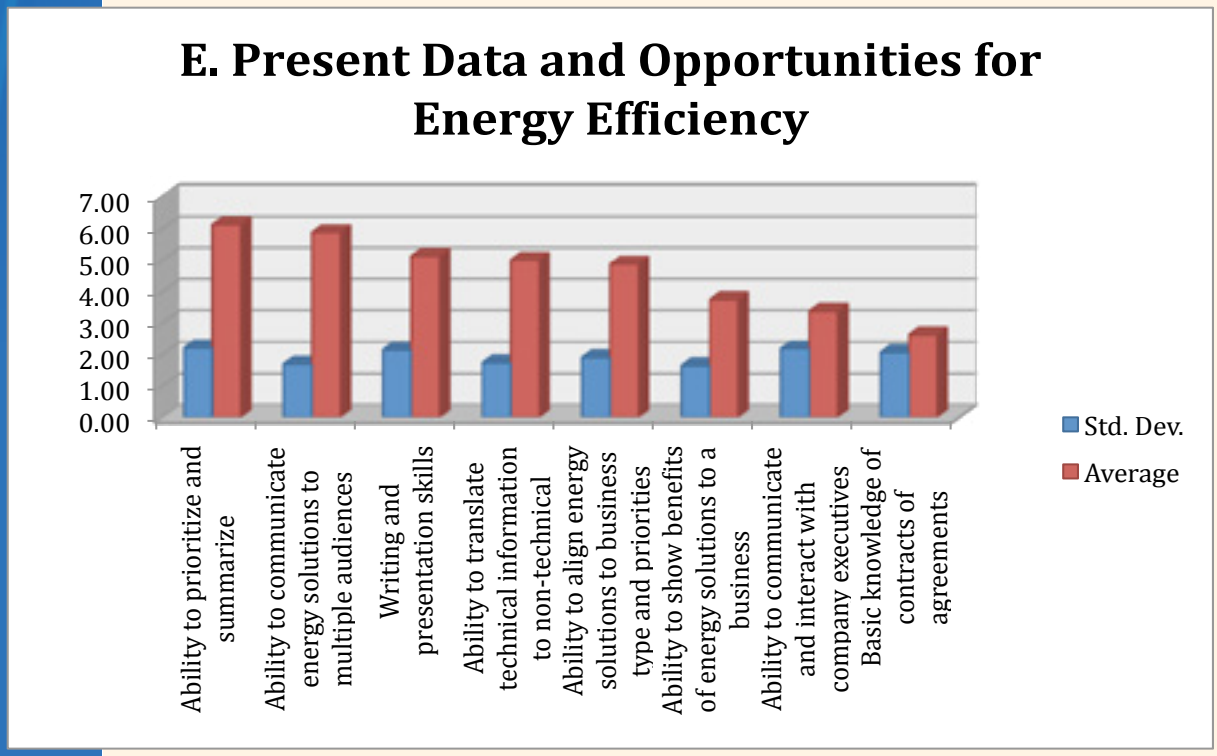


Figure B-6. Ranking of Skills: Communications with Customers and Other Stakeholders

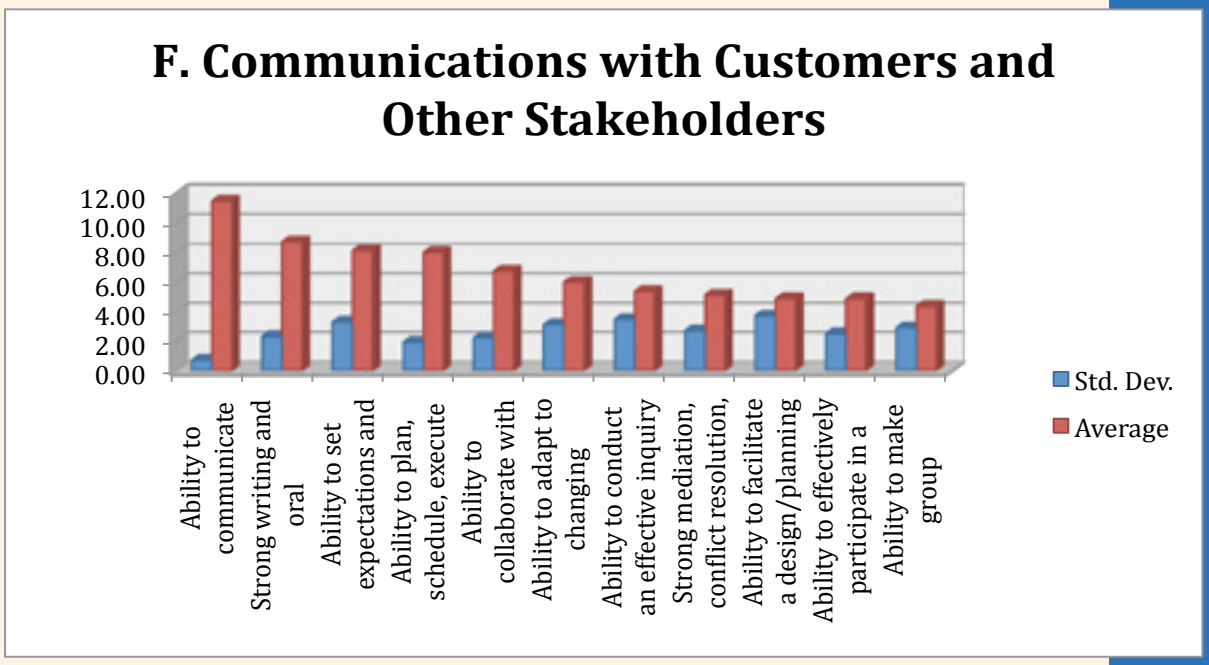
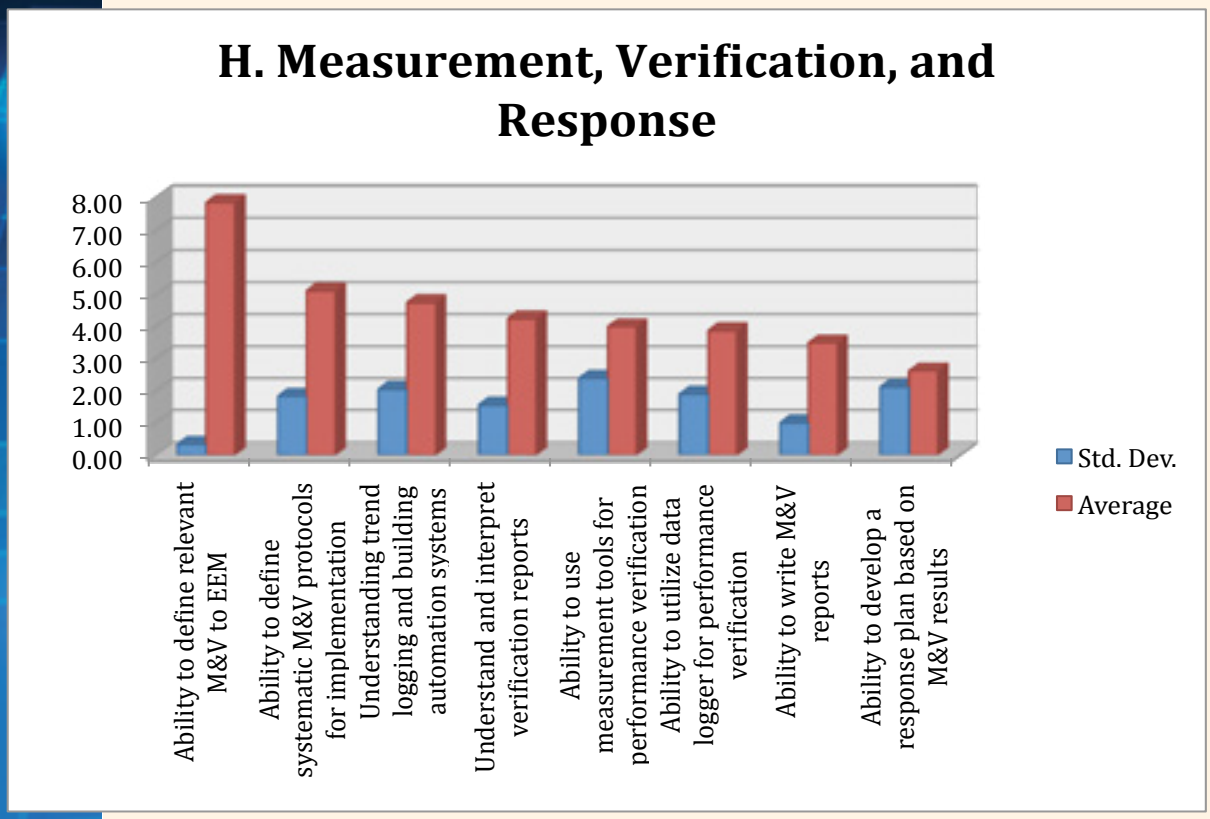


Figure B-7. Ranking of Skills: Professional Standards, Ethics, and Leadership

Figure B-8. Ranking of Skills: Measurement, Verification, and Response



Summary of the Results of the Core Skill Analysis:
Energy Program/Project Management

Note: The following table summarizes the results of Chart 5, in order to conserve space and resources.

Summary of Chart 5: Undercovered Core Skills * — **Career Area: "Energy Project/Program Management"**

("X" indicates skill is undercovered. Skills are shown in order of importance within each CWF)

	A. Manage people	Cascadia	EdCC
A1	writing		X
A15	Technical competence		X
A10	Motivate people		X
A9	Leadership		X
A11	Delegation		X
A18	Organizational skills		
A19	Self-starter, self-motivated		
A3	Time management (prioritize effectively)		X
A5	Conflict resolution		X
A8	Team building skills		X
A6	Ability to provide constructive feedback		X
A12	Understanding personal work styles		X
A7	Recognize employees' performance		X
A14	People sense		X
A17	Strategic thinking		
A4	Accessibility (open door policy)	X	X
A16	Ability to identify staffing and skill gaps	X	X
A13	Counsel and advise	X	X
A2	Ability to estimate hours to perform tasks		X

	B. Manage budgets	Cascadia	EdCC
B1	Excel spreadsheet		
B3	Technical competencies about the work		
B6	Communicating and documenting budgets	X	X
B4	Estimating costs	X	
B11	Strategies to stay within budgets	X	X
B2	Estimating hours	X	X
B13	Matching employee skills to tasks	X	X
B7	Math skills		
B5	Basic accounting skills	X	
B6	Ability to identify gaps		X
B10	Understanding 3rd party capabilities	X	
B12	Market analysis	X	
B9	Comparative analysis		

	C. Develop & implement proposals	Cascadia	EdCC
C1	Technical writing skills		X
C3	Systems knowledge		X
C11	Concept development		X
C6	Technology knowledge		
C4	Cost analysis	X	X
C8	Team coordination skills		X
C9	Strategic thinking		X
C5	Resource needs		X
C7	Creative thinking		
C14	Presentation skills		
C10	Sales ability	X	X
C12	Stakeholder coordination skills		X
C2	Research		
C13	Interviewing skills (as proposer)	X	

	D. Educate & Train	Cascadia	EdCC
D1	Communication		
D3	Technical expertise		
D9	Ability to identify staff skill needs	X	X
D8	Education resources and tools		
D2	Presentation		
D4	Organizational development	X	X
D7	Track technology trends		
D5	Educational strategies		X
D6	Vendor relations	X	X
D13	Provide feedback to employees	X	X
D11	Coordination skills		
D10	Multicultural understanding	X	
D12	Post-training assessment	X	X

	E. Direct research, analysis & assessment	Cascadia	EdCC
E1	Technical knowledge		
E4	Analytical skills		
E6	Building systems technical knowledge		
E3	Specialize software skills		X
E7	Applied physics		
E5	Math skills		
E2	Spreadsheet skills		X
E10	Plan reading/understanding		X
E8	Brainstorming skills		
E9	Communication		
E13	Economic analysis (LCCA)		
E14	Data management skills		X
E11	Metering experience	X	X
E12	Ability to use and maintain equipment	X	

	F. Coordinate external funding & incentives	Cascadia	EdCC
F3	Knowledge of funding programs	X	
F1	Communication		X
F6	Rapport with external parties	X	
F2	Financial acumen	X	
F5	Spreadsheet skills		
F10	Knowledge of current energy code		
F4	Math skills	X	
F7	Organization skills	X	X
F9	Negotiation skills	X	X
F8	Technical writing skills		
F11	Knowledge of policy context		

	G. Communicate	Cascadia	EdCC
G3	Ability to build and foster relationships		X
G5	Customer outreach	X	X
G7	Listening skills		
G1	Technical writing		
G4	Email skills	X	
G6	Phone skills	X	X
G2	Presentation skills		
G9	Negotiation skills		X
G8	Organizational skills		

	H. Meet regulation policies, codes & stds (internal & external)	Cascadia	EdCC
H2	Knowledge of codes		X
H1	Knowledge of regulations		X
H3	Knowledge of standards		X
H5	Analysis and interpretation		
H4	Research skills		
H6	Integrate into design/documentation		X
H9	Communication		
H8	Negotiation skills	X	X
H12	Understanding of indust. best practices/benchmarking		
H10	Presentation skills		
H7	Corrective action	X	
H11	Post-mortem training (lessons learned)		X

A skill is considered "Undercovered" if its Coverage score is below 75% of the Scaled Average Target value.

Chart 6:

Severity of Undercoverage at the CWF Level

Measured as a percentage of undercoverage of the top 50% of the rank-ordered skills. (Highlighted if over 50%)

Career Area: "Energy Project/Program Management"

	Critical Work Function	Cascadia # of under-covered skills in top 50%	Cascadia %	EdCC # of under-covered skills in top 50%	EdCC %	
7	A. Manage people	0	0	8	84	
8	B. Manage budgets	5	77	4	62	<== Both severely undercovered
9	C. Develop & implement proposals	1	14	6	86	
10	D. Educate & Train	2	31	2	31	
11	E. Direct research, analysis & assessment	0	0	2	29	
12	F. Coordinate external funding & incentives	3	55	1	18	
13	G. Communicate	2	44	2	44	
14	H. Meet regulation policies, codes & stds (internal & external)	0	0	4	67	

Summary of the Results of the Core Skill Analysis:
Commercial Building Analysis

Note: The following table summarizes the results of Chart 5, in order to conserve space and resources.

Summary of Chart 5: Undercovered Core Skills *

Career Area: "Commercial Building Analyst"

("X" indicates skill is undercovered. Skills are shown in order of importance within each CWF)

	A. Assess requirements and design opportunities	Cascadia	EdCC
A8	Foundational building systems knowledge	X	X
A2	Construction and design principles		X
A3	Experience with on-site assessment of facilities	X	X
A7	Data gathering and documenting skills		
A1	Knowledge of how to use energy and industry codes		X
A4	Interpersonal/interviewing skills	X	X
A6	Planning and organizational skills		
A10	Understanding sustainability principles		
A5	Research skills		
A9	Knowledge of organizational of human behavior		

	B. Identify building systems, functions, and interactivity.	Cascadia	EdCC
B1	Foundational building systems knowledge		
B5	Understanding how different commercial HVAC syst. function		X
B3	Knowledge of different building automation systems	X	X
B4	Ability to use basic diagnostic tools		
B8	Understanding interactions between different building systems		
B10	Basic understanding of elec'ty, and how elect. systems work		
B2	Ability to read plans/schematics		
B15	Understanding of facility operations and maintenance services	X	
B11	Basic understanding of fluid dynamics		X
B6	Ability to ascertain and document assumptions/ estimations (estimating		
B12	Psychrometrics (pressure, humidity, and temperature)	X	
B7	Knowledge of different lighting technologies		
B9	Ability to assess occupant safety and health impacts of bldg. systs.	X	
B14	Knowledge of personal safety and protection	X	
B13	Knowledge of building toxicity issues (mold, asbestos, lead, etc.)		

	C. Energy information modeling and analysis	Cascadia	EdCC
C4	Understand typ. enegy effic'y measures—how/when to apply them		
C5	Understanding energy units of measure		
C2	Ability to create and manipulate spreadsheets		X
C7	Understanding science of energy modeling (thermodynamics)	X	X
C6	Understanding modeling tools and limitations		X
C9	Ability to benchmark calc'd results to rules of thumb (reality check)		
C8	Understanding energy economics and rate structures		
C10	Basic understanding of statistics and their application	X	X
C1	Advanced computer analys. (bldg. simul'n. modeling software)		X
C13	Knowledge of old energy benchmarking tools(Portfolio Manager, EUI, ECI, ES, CBECS)		
C3	Understanding of energy generation and distribution systems		
C12	Knowl. of metering technol's and understanding load profiles	X	
C11	Ability to use climate data to normalize energy data	X	

	D. Economic and business case development	Cascadia	EdCC
D2	Understanding of project economic analysis methodologies (LCCA, ROI, Simple Payback, discount rate, savings to investment ratio)		
D3	Understanding basic business economics and management	X	X
D4	Ability to evaluate financial tools/resources for projects	X	X
D9	Writing and presentation skills		
D6	Knowledge of construction cost estimation	X	X
D1	Ability to define and evaluate contractors and proposals	X	X
D5	Understanding basic maintenance functions and cost		
D7	Ability to quantify/qualify environmental benefits		
D8	Ability to identify and describe non-energy benefits to business ops.		

	E. Present data and opportunities for energy efficiency.	Cascadia	EdCC
E4	Ability to prioritize and summarize		
E2	Ability to communicate energy solutions to multiple audiences		
E1	Writing and presentation skills		
E3	Ability to translate tech. information to non-tech. audiences		
E6	Ability to align energy solutions to business type and priorities		X
E7	Ability to show benefits of energy solutions to a business		X
E9	Ability to comunic'te and interact with co. execs and stakeholders	X	
E5	Basic knowledge of contracts of agreements	X	X

	F. Communications with customers and other stakeholders	Cascadia	EdCC
F2	Ability to communicate professionally		X
F6	Strong writing and oral communication skills		X
F1	Ability to set expectations and deliverables		X
F12	Ability to plan, schedule, execute projects, and to meet deliverables		X
F9	Ability to collaborate with other technical experts	X	X
F8	Ability to adapt to changing circumstances		X
F11	Ability to conduct an effective inquiry process		
F7	Strong mediation, conflict resolution, and negotiation skills		X
F4	Ability to facilitate a design/planning process		X
F5	Ability to effectively participate in a group environment		
F3	Ability to make group presentations to various stakeholders		X
F10	Ability to teach benefits of energy solutions and technology apps		

	G. Professional standards, ethics, and leadership	Cascadia	EdCC
G3	Ability to self-direct personal professional development		X
G2	Ability to effectively collaborate with peers and competitors (to advance the		X
G1	Ability to understand & integrat tech codes, regs, & protocols		X
G6	Ability to understand and apply emerging trends to the profession	X	
G7	Ability to support a learning environment in the workplace		X
G4	Understanding of relevant professional certifications and credentials		
G5	Understanding of relevant professional associations and opportunities		
G8	Ability to teach and mentor peers, colleagues, and students		

	H. Measurement, verification, and response	Cascadia	EdCC
H1	Ability to define relevant M&V to IEM		
H2	Ability to define systematic M&V protocols for implementation		
H7	Understanding trend logging and building automation systems		
H5	Understand and interpret verification reports	X	
H4	Ability to use measurement tools for performance verification		
H3	Ability to utilize data logger for performance verification		
H6	Ability to write M&V reports	X	
H8	Ability to develop a response plan based on M&V results	X	

*A skill is considered "Undercovered" if its Coverage score is below 75% of the Scaled Average Target value.

Chart 6:
Severity of Undercoverage at the CWF Level

Career Area: "Commercial building Analysis"

Measured as a percentage of undercoverage of the top 50% of the rank-ordered skills. (Highlighted if over 50%)

Critical Work Function	Cascadia # of under-covered skills in top 50%	Cascadia %	EdCC # of under-covered skills in top 50%	EdCC %		Total # of skills in CWF	# skills in top 50%
A. Assess requirements and design opportunities	2	40	4	80		10	5
B. Identify building systems, functions, and interactivity.	2	27	2	27		15	8
C. Energy information modeling and analysis	1	15	3	46		13	7
D. Economic and business case development	3	67	3	67	<== Both severely undercovered	9	5
E. Present data and opportunities for energy efficiency.	0	0	0	0		8	4
F. Communications with customers and other stakeholders	1	17	6	100		12	6
G. Professional standards, ethics, and leadership	1	25	3	75		8	4
H. Measurement, verification, and response	1	25	0	0		8	4

Special thanks to our focus groups for their participation.

Commercial Building Analysis Focus Group (left to right): Gaurav Mehta (Stantec), Richard Ma (McKinstry), Perry Spring (Clallum County), Chuck Peterson (Snohomish County PUD), Sangeetha Divakar (CDi Engineers), Mark Lensson (Puget Sound Energy), Kevin Laycock (EcoFab), Rob Marks (Snohomish County PUD)

Energy Project/Program Management Focus Group (left to right): Haida May Malcome (Puget Sound Energy), Chris Roe (Boeing), Brian Hanson (McKinstry), Hillary Olson (Snohomish County PUD), Mark Nieman (McKinstry), Leslie Jonsson (CDi Engineers), Jeff Carter (Fluid Market Strategies)

Washington State University Extension Energy Program

Edmonds Community College

Cascadia Community College

Center of Excellence for Clean Energy