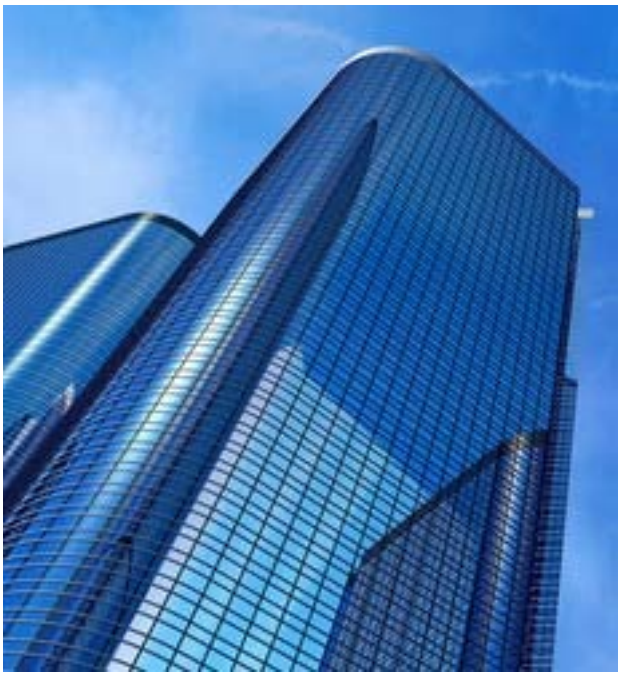

# ENERGY EFFICIENCY TRAINING

## Expansion of PG&E Energy Center Training into Community Colleges


ABSTRACT

PG&E has partnered with the California Community Colleges to expand the geographic footprint of its Energy Training Programs beyond current locations in San Francisco, Stockton, and San Ramon. The partnership provides PG&E curriculum and subject matter expertise to update existing community college certificate and degree programs with leading edge industry content. This report highlights the process that was used to engage the colleges and outlines next steps for integration of PG&E curriculum into programs for Building Science, Lighting, HVAC, and Energy Analysis and Auditing.


WORKFORCE INCUBATOR

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## Contents

## Executive Summary

Pacific Gas & Electric (PG&E) offers a wide array of leading-edge energy training courses through its training centers in San Francisco, Stockton, and San Ramon. In 2014, PG&E produced a Roadmap for expansion of its key energy curricula into colleges and universities as part of its three-year Energy Workforce Sector Strategy Project (see www.eesectorstrategy.com ). This Roadmap laid the groundwork for relationships between PG&E and up to two dozen post-secondary institutions committed to adaptation and delivery of PG&E courses and programs into college/university courses in order to extend the reach of these training resources and enhance their long-term sustainability through shared resources.

The Energy Center Training Expansion Project is a key part of PG&E's Workforce Education and Training program, a specific initiative included in the California Long-Range Energy Efficiency Strategic Plan. Its goal is: "By 2020, California's workforce (will be) trained and fully engaged to provide the human capital necessary to achieve California's economic energy efficiency and demand-side management potential."

**Project Scope**
The project consists of four primary tasks designed to facilitate agreement between PG&E and colleges and universities for expanding energy training programs:

1. Create a framework for agreement which commits development and delivery of courses/programs to extend the footprint of current Energy Center programs
2. Develop a Statement of Benefits defining the value PG&E is bringing to participating colleges and what PG&E hopes to gain by having its programs disseminated by colleges
3. Provide guidance and support to colleges and universities in developing their plans for adaptations of PG&E curricula within their courses
4. Provide ongoing collaboration with colleges to enhance their plans, incorporate "best practices" identified from college proposals, and facilitate long-term sustainability and regional collaboration among colleges, employers, and Workforce Investment Boards.

**Curriculum Being Shared**
PG&E identified four priority training topic areas out of its portfolio of approximately 100 courses and workshops. These are:

1. Building Science Fundamentals for Energy Efficiency
2. Commercial Building Energy Audits and Analysis
3. HVAC Technician Commercial Quality Installation and Maintenance
4. Lighting Technology and LEW Design (Light + Efficiency + Wellbeing)

A Technical Lead person with deep expertise and experience oversees each training topic area and will support participating colleges with guidance and technical assistance.

**Objective and Results**
PG&E's project objective is to collaborate with colleges to infuse its curricula into academic courses and programs. This will enable valuable market-tested energy education to become available to more new and incumbent workers in order to enhance their skills to meet California's growing demand for a highly skilled energy workforce.

The following report describes the process by which these post-secondary education partnerships have been created and incorporates documents and tools that were utilized to achieve these results. Hopefully, it will prove a useful guide for future curriculum exchanges by PG&E and other utilities. It is organized into three sections: a description of the drivers that led to the project; Best Practices that derived from solicitation responses and from a convening of the colleges and PG&E technical program coordinators; and next steps in bringing the project to fruition. Appendices include descriptions of the offered curriculum and the solicitation application completed by the participating colleges.

## Acknowledgments

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**Participating California Colleges and Universities:**
Cabrillo College
Fresno Community College
Kern Community College District
Laney College
Mendocino College
Sacramento City College
Skyline College
Sierra College
UC Santa Cruz
West Hills College - Coalinga
West Hills College - Lemoore
West Valley College

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## Scope

Pacific Gas and Electric Co. ("PG&E") operates regional training centers that offer courses in all aspects of energy efficiency, including the design, installation, commissioning, operation, and maintenance of energy efficient lighting, heating, ventilation, air conditioning, and refrigeration systems in commercial and industrial buildings. These courses, while teaching the latest updates to codes, standards, and best practices, have a limited reach in terms of the student audiences addressed. To expand the reach of these programs and increase their impact on workforce competency in promoting California's energy efficiency goals and mandates, PG&E offered curriculum and expertise in four topic areas to California Community Colleges in its service territory through a solicitation. Approximately 25 institutions indicated interest in receiving the curriculum to enhance their programs; 11 institutions received awards. The four topic areas were:

Building Science Fundamentals for Energy Efficiency
: Introduction to fundamental building energy efficiency concepts such as heat transfer, airflow management, moisture management, and solar geometry for improved understanding of how building design and construction techniques affect energy use

Commercial Building Energy Audits and Analysis
: Explore concepts of energy auditing, energy measurement, analyzing building envelope, assessing building mechanical systems, identifying opportunities for energy efficiency, calculating energy use and savings, energy modeling tools, and business development skills for writing audit reports

HVAC Technician Commercial Quality Installation and Maintenance (QI/QM)
: QI/QM programs specifically dealing with the installation and maintenance of commercial heating, ventilation, and air conditioning/refrigeration systems

Lighting Technology and LEW Design (Light + Efficiency + Wellbeing)
: Lighting technology modules include Lighting Design, Title 24 Code, Lighting Technology, Lighting Controls, and Lighting Retrofits.
LEW Design (Light + Efficiency + Wellbeing) will consist of five new three-hour modules, to be completed in Q1 2015.

Detailed descriptions of the curriculum offerings are in Appendix A.

The following is a matrix of colleges winning awards under the solicitation (Appendix B):

| College | Region | Building Science | Energy Audits | HVAC | Lighting |
|---|---|---|---|---|---|
| Cabrillo College (with UC Santa Cruz) | Bay | X | | | |
| Laney College | Bay | X | | X | X |
| Skyline College | Bay | X | X | X | X |
| West Valley College | Bay | X | X | | X |
| Fresno City College | Central Valley | | X | X | X |
| Kern Community College District (representing 14 colleges) | Central Valley | X | X | X | X |
| West Hills College – Coalinga | Central Valley | | | X | |
| West Hills College – Lemoore | Central Valley | | X | | |
| Mendocino College | North | X | | X | X |
| Sacramento City College | North | | X | X | |
| Sierra College | North | X | X | | X |

## Where the Jobs Are

Labor market analysis was a key component of the solicitation. Programs represented in the 11 awarded applications targeted 50 unique job titles in energy efficiency-related occupations, representing over 10,000 annual job openings in the PG&E territory alone. The average application targeted 7 job titles with greater than 2,500 annual region-wide openings. Labor Market Information (LMI) for targeted jobs is shown in the figures below. Figure 1 identifies annual openings within the applicants' regions for job classes targeted in their applications, and identifies the top five job classifications by annual openings and percentage of total annual openings for those jobs within applicants' regions (e.g., Bay Area colleges identified jobs with 4,084 annual openings within the Bay Area).


**Figure 1: Regional Annual Openings for Targeted Jobs**

## Best Practices

Best Practices fell into two categories in the roll-out of the project: 1) Those identified for implementation by colleges receiving curriculum; and 2) those identified as impacting the roll-out of the project itself.

### Awardee Best Practices

Six were identified from the college proposals:

1. Leverage a community college initiative to develop regional networks of colleges with a Network Facilitator for each topic in the region.

    The Community Colleges' Energy Efficiency and Utilities (EE&U) Sector Team previously formed Expert Networks for faculty professional development among each sub-region's colleges. These Expert Networks are in the process of being reconfigured to align with the four PG&E priority topic areas. Further, the Prop 39 program provides the colleges a source of funding for professional development, curriculum development, and lab upgrades to complement the PG&E Energy Training Expansion project.

2. Build collaboration among colleges and sharing of resources (e.g., labs, online learning content and tools); online component for distance learning and incumbent worker training.

    Several novel approaches to the sharing of content, tools, and other resources were represented in the applications. One college offered itself as a "wholesale" deliverer of curriculum; not offering the curriculum itself, but providing both on-site and on-line lab facilities for regional and distance learning.

3. Support articulation among colleges for continued student advancement opportunities; at minimum for schools within region or regional network.

    "Lateral" articulation addresses a workforce that is mobile and colleges that are increasingly specialized. Some of the curriculum offered crosses college boundaries, so these lateral articulation agreements recognize training offered at multiple colleges for the single purpose of enhancing worker energy efficiency competence (versus traditional "vertical" articulation agreements between high schools, community colleges, and universities).

4. Organize Expert Network sessions around priority topic areas to include all participating colleges in PG&E service territory.

    This practice promotes curriculum sharing and faculty development on a broad scale. The PG&E service territory is quite large, so colleges offering campus facilities for regional gatherings helps maximize participation and minimize costs. Sacramento City College has offered its campus and facilities for these types of meetings.

5. Employ experiential learning as an integral part of curriculum adaptation.

    Experiential learning was a critical element of successful applications. It was emphasized that hands-on training in these topic areas was a vital element of knowledge infusion. Colleges were strongly encouraged to make campus facilities available as living laboratories for students.

6. Market programs to disadvantaged populations.

    This is a core principle for the California Community College System, and a key element of some awardee applications. The jobs targeted by the applications are significant in number and create higher wage opportunities for new job market entrants and career changers.

**Other Best Practices**

1. Train-the-trainer.

   Where feasible, the curriculum provider should work with Colleges' regional networks to schedule Train-the-Trainer courses, updated periodically as codes and standards change in ways that materially impact the curriculum offered. Such sessions should be recorded for later reference by other faculty.

2. Curriculum modules are more straightforward to infuse than complete courses.

   Community Colleges are bound under certain statutory restrictions when adopting complete courses; such restrictions consume a lot of time. A new course will take approximately one year before it is ready to be delivered.

3. Minimize prerequisites / recognize on-the-job training (OJT) experience of incumbents.

   Work with faculty to clearly identify knowledge, skills, and abilities (KSAs) that are prerequisite to understanding the course material being offered. Prerequisites can be a barrier to participation, particularly to incumbent workers who may have adequate OJT training to be capable of absorbing curriculum content.

4. Tool lending libraries.

   PG&E has an excellent tool lending library available to Community Colleges for the cost of shipping the tools. This is both an excellent resource to provide to spur adoption of curriculum and one that is highly recommended to colleges to take advantage of.

5. Program co-marketing.

   The industry “seal of approval” on curriculum is a key recruiting advantage for adopting colleges. Co-marketing through co-branding on web sites (by colleges and PG&E) is a simple, low cost method for making students aware of both where industry-leading training is available and what the source of that training is.

6. Graduation job fair.

   One very interesting practice that came from an awardee college was that of combining graduation ceremonies from energy-related programs with a job fair in which hiring employers were invited to the graduation, given a packet of resumes of all graduates, and encouraged to meet and interview graduates on the spot. This practice can be adapted for many different contexts.

6. Include quiz/exam materials.

   Sample tests and exercises are an important part of any curriculum offering and will help ensure that adapting institutions achieve learning outcomes that are consistent with the goals of the curriculum being offered.

7. Use industry resources.

   A number of free or low-cost industry training resources were recommended by both PG&E and the colleges (e.g., Schneider Electric's Energy University, building science exercises from PASCO Scientific, and agentsofchange.com).

8. Regional industry collaboratives.

   In the long term, the test of the effectiveness of this curriculum expansion project will be told in terms program graduates deployed across a range of businesses using their skills to move those enterprises toward achievement of the AB 32 goals. While PG&E is expert in the field of delivering energy to its customer base and the community colleges are expert in delivering the knowledge sets necessary for students to develop marketable skills, two other important partnerships must be more fully developed. Participation of businesses and the workforce development community at the local and regional level is essential to the success of this endeavor. To this end, the Community College Sector Navigator has undertaken a project to stand up regional sector “collaboratives” focused on the talent needs of businesses employing energy efficiency professionals including construction, government, facilities management companies, hospitals and health care operations and a host of other businesses. In this

utilization, a collaborative is descriptive of an entity that is established with cross-disciplinary representation from industry, education, business, economic development, workforce, labor, and other business and labor force serving organizations. This model is recognized nationally as a best practice public/private partnership model. For the energy industry, an example of this collaborative model exists in the Energy and Construction Sector Collaborative active in the Sacramento region. For additional information on this model see Appendix C.

## Next Steps

1. Schedule Train-the-Trainer courses for each topic area. Logistics may be complicated, so it is recommended that these courses be video-recorded for later access by faculty via webinar where feasible. The EE&U Sector's Prop 39 Project Directors will act as coordinators for Community Colleges' participation.
2. PG&E Technical Program Coordinators will deliver curriculum packages to awardee colleges and lead the Train-the-Trainer faculty development sessions.
3. Prop 39 Project Directors will work with colleges to identify funding needs and sources for curriculum development and professional development (e.g., Train-the-Trainer) activities, and for any capital requirements (equipment, software, etc.). They can also explore the feasibility of developing a shared website for collaborative online learning.
4. The Cabrillo College Built Environment Learning Lab (BELL) facility in Watsonville can be a PG&E region-wide training resource for a number of energy efficiency disciplines; recommend that the EE&U Sector Team assist in assessing how this resource can be best utilized and promoted.
5. Periodic Regional Expert Network convenings to assess how the colleges are doing, solicit assistance, and promote best practices. Regional WIBs should be invited to these meetings as they represent both a pipeline of students into courses and a pipeline of hiring employers for graduates.

# Appendix A
# Priority Topic Areas

| **Building Science Fundamentals for Energy Efficiency: Heat, Moisture, and Air – A Designer's Guide** | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| Understanding the relationship between heat, air and moisture is essential in designing efficient, durable and comfortable buildings (commodity, firmness and delight). Yet, Psychrometry is traditionally taught without reference to design. This module focuses on understanding the interaction of heat, air, and moisture in as they affect human comfort, and HVAC and enclosure design. As designers understand these concepts they will be better able to communicate to their consultants design goals and, more importantly, how to achieve those goals. | Describe the variation in the ability of air to hold water vapor with changes in temperature.<br>Describe what causes water to condense out of air or to evaporate into air.<br>Define relative humidity, dew point, and saturation line.<br>Understand sources of water and moisture and basic approaches to using control layers to them in building assemblies.<br>Have the knowledge base to take more advanced classes on design of the building envelope for energy efficiency and moisture control. | Identify the 6 major factors affecting human comfort.<br>Identify the major assumptions associated with the ASHRAE comfort zone (Radiation = Ambient, no air movement etc.)<br>Discuss BTU as an energy currency in achieving thermal comfort.<br>Discuss the definition of Sensible Heat.<br>Discuss the definition of Latent Heat.<br>Discuss basic digital method for translating climate information into a design context (bioclimatic chart and comfort zones).<br>Discuss Psychrometric perspective, of how compressor cooling works.<br>Discuss how Psychrometry informs wall assembly design. | Architects, Engineers, Designers, Building Contractors, Construction Site Supervisors. |
| Materials Provided | 52 presentation slides* | | |

* The number of slides available may be less depending upon review of third party copyright restrictions.

| **Building Science Fundamentals for Energy Efficiency: Heat Transfer and Building Assemblies** | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| Understanding heat movement is fundamental in designing energy efficient buildings. The aim of this program is to equip architects and designers with the intuitive basis for designing around heat transfer concerns. We will review radiation, conduction and convection, the three primary modes of transfer, and then use specific examples of these phenomena in buildings to illustrate design choices. | List the three fundamental mechanisms of heat transfer.<br><br>Identify at least one method of mitigating heat transfer for each of the fundamental heat transfer mechanisms.<br><br>Trace the thermal control layer of a building enclosure detail, and identify three common heat transfer short circuits in building enclosures.<br><br>Describe the effect of thermal mass as a thermal ballast (fly wheel), and air as a moving thermal mass transfer element. | A Small Business<br><br>Demo: What is Temperature?<br><br>Conduction and Convection<br><br>Radiation<br><br>Practical Considerations<br><br>Whole Building Considerations<br><br>Other Forms of Heat Transfer<br><br>Thermal Mass | Architects, Engineers, Designers, Building Contractors, Construction Site Supervisors. |
| Materials Provided | 64 presentation slides* | | |

* The number of slides available may be less depending upon review of third party copyright restrictions.

| **Building Science Fundamentals for Energy Efficiency: Low-e Glass and Low-Energy Building Design – An Introduction** | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| This module covers how low-emissivity (low-e) and spectrally selective coatings affect the performance of window glass. Also covered are the impact of framing material and spacers on thermal performance. There is a brief review of prescriptive requirements under 2013 Title 24 Building Energy Standards for residential and nonresidential windows. | Understand basic physical principles of heat gain and loss at glazed areas of the building envelope<br>Recognize the basic metrics for glass and window performance and how to apply them in new construction and building renovation<br>Gain an understanding of emissivity as it applies to building materials<br>Discern the differences among the range of low-e glass products and know what product types are appropriate to a given building and climate<br>Have gained an overview of Title 24 U-factor and SHGC requirements for nonresidential and residential buildings and know sources of additional information | Methods of Heat Transfer<br>Heat Loss and U-Factor<br>Heat Gain and Solar Heat Gain Coefficient<br>Thermal Energy<br>Solar Heat<br>Visible and Infrared Wavelengths<br>Emissivity<br>Low-e Coatings and Glass<br>Reducing Winter Heat Loss<br>Spectrally Selective Coatings and Glass<br>Reducing Summer Heat Gain<br>The Impact of the Frame<br>Financial Incentives<br>Window Choices and Whole Building Energy Use | Architects, Engineers, Designers, Building Contractors, Construction Site Supervisors. |
| Materials Provided | 81 presentation slides* | | |

* The number of slides available may be less depending upon review of third party copyright restrictions.

| Building Science Fundamentals for Energy Efficiency: Solar Geometry | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| The sun's relationship with the earth has implications for enclosure design, daylighting and mechanical and electrical systems.<br><br>Is the sun a problem or an opportunity for building designers? In order to design sun and climate-responsive buildings, architects need to understand where the sun is in the sky and how that position changes, seasonally and daily. This module covers methods to take advantage of the regularity of the sun's place in the sky to effectively daylight, heat, or power a building, while reducing overheating and controlling glare. | Gain the ability to:<br><br>1. Describe the seasonal position of the sun and how the sun's position changes over the course of a day<br><br>2. Identify differences associated with the sun's seasonal and daily variations in terms of heat gain and resource for on-site generation of electricity.<br><br>3. Gain awareness of digital and graphic tools used to explore and analyze the sun's relationship to buildings and place.<br><br>4. Determine the sun's impact on building for a given location and time, and demonstrate how the sun "views" a building. | Seasonal variations in the position of the sun.<br><br>How the sun's position changes over the course of a day.<br><br>Differences in radiant energy falling on earth and building surfaces resulting from the sun's seasonal and daily variations.<br><br>Introduction to digital tools that enable exploration and analysis of the sun's relationship to buildings and place.<br><br>Techniques to analyze the sun's impact on building for a given location and time.<br><br>How the sun "views" a building. | Architects, Engineers, Designers, Building Contractors, Construction Site Supervisors. |
| Materials Provided | 62 presentation slides* | | |

* The number of slides available may be less depending upon review of third party copyright restrictions.

| Commercial Building Energy Audits and Analysis: Program-Level Information | | | |
|---|---|---|---|
| Program Description | Learning Objectives | Syllabus | Target Audience |
| Explore concepts of energy auditing, energy measurement, analyzing building envelope, assessing building mechanical systems, identifying opportunities for energy efficiency, calculating energy use and savings, energy modeling tools, and business development skills for writing audit reports. Consists of 15 course modules, developed with a grant from the California Community College Chancellor's Office of Economic & Workforce Development. PG&E strongly encourages practicum through student access to campus facilities and equipment | Describe the basic concepts of energy auditing, including fundamentals of energy, energy measurement, energy conservation, and the policies driving the need for energy efficiency.<br><br>Analyze building envelope, assess building systems, describe how building systems consume energy, and identify opportunities for energy efficiency.<br><br>Employ appropriate tools for energy modeling, calculating energy use and savings estimates, and communicating empirical data.<br><br>Describe utility rate structures and demand response strategies.<br><br>Estimate energy savings and their financial impacts, and employ data to verify savings.<br><br>Integrate business development skills and concepts to write an audit report that is a call to action and identifies the value proposition for the decision maker. | Intro to Commercial Building Audits<br><br>MS Excel & Word for Energy Auditing<br><br>Energy & Building Science Fundamentals<br><br>Utility Rates, Benchmarking and Financial Analysis<br><br>Lighting Systems and Controls<br><br>HVAC Fundamentals and Components<br><br>Building Envelope Systems<br><br>Miscellaneous Building Systems<br><br>Demand Response for Energy Auditors<br><br>HVAC Systems and Efficiencies<br><br>Simulation Methods and Code Compliance<br><br>Professional Behavior for Energy Auditors<br><br>Measurement Tools and Verification of Savings Calculations<br><br>Field Experience with Reporting<br><br>Audit Report Writing | Building operators, facility managers, energy consultants, and HVAC engineers. Also could be adapted to designers for existing buildings. |
| Materials Provided | Curriculum for any or all of 15 courses, instructor slides, classroom exercises, homework assignments, exam materials, quizzes, mock audits, tables, and calculations | | |

| Commercial Building Energy Audits and Analysis | | | |
|---|---|---|---|
| **Intro to Commercial Building Audits (36 Hours)** | | **MS Excel & Word for Energy Audits (36 Hours)** | |
| Module Description | Learning Objectives | Module Description | Learning Objectives |
| Overview of the energy auditing process for commercial buildings. Topics include various levels of audits, defining scope of work, preliminary assessment of building performance data, collection and assessment of building system operations, analysis of data, developing recommendations, report preparation and presentation. | Describe the various levels and phases of work for commercial building audits.<br>Describe and classify the types of data collected for use in a commercial building audit.<br>Describe field safety considerations and techniques necessary for on-site building assessments.<br>Analyze data in order to identify opportunities to reduce energy consumption and improve building operational efficiency, and formulate action recommendations.<br>Estimate financial implications of recommended upgrades.<br>Integrate findings and recommendations into a written report. | Overview of Microsoft Excel as used for common engineering applications, with a focus on energy savings calculations. It covers Excel basics, such as navigation techniques, keypad short cuts, graphing, and calculations. Advanced topics include regressions, pivot tables, lookup, dates and macros. | Demonstrate fundamental use of spreadsheet basics.<br>Create and interpret graphs.<br>Illustrate the use of Excel's built-in functions and the functions commonly used by engineers.<br>Interpret simple regression analysis directly from graph data using various trend lines.<br>Create and apply macros and pivot tables on existing data. |

| Commercial Building Energy Audits and Analysis | | | |
|---|---|---|---|
| **Energy and Building Science Fundamentals (36 Hours)** | | **Utility Rates, Benchmarking & Financial Analysis (36 Hours)** | |
| Module Description | Learning Objectives | Module Description | Learning Objectives |
| Fundamental concepts for understanding energy use in commercial buildings. Principles of energy, heat transfer, measurement and unit conversion, phase change, psychrometrics. Balance point and emissivity, delta flows, solar geometry. Energy efficiency improvement strategies. | Summarize the basic concepts of energy, including the first and second laws of thermodynamics, work, and power.<br>Measure electricity, heat, pressure, and light, and calculate unit conversions to determine energy use in buildings over time.<br>Analyze environmental conditions using the psychrometric chart and processes, and relate observations of variances in the environment to energy use in buildings.<br>Describe and compare energy concepts including heat transfer, change of state or phase change, balance point, emissivity, and delta flows.<br>Describe concepts of solar geometry and relate them to building science. | Utility rate types and charges. Building benchmarking tools such as EnergyStar Portfolio Manager and LBNL's Energy IQ. Methods for estimating costs, and calculating the financial benefits of recommended energy efficiency projects. | Compare tariff and rate schedules used by utilities to determine customer energy bills.<br>Use multiple tools to analyze billing data for commercial buildings.<br>Assess the impact of building type, climate and occupancy patterns and tenant use on commercial building energy use.<br>Use benchmarking tools to compare the Energy Use Intensity of buildings of similar type and climate, and illustrate typical energy use patterns of specific facility types.<br>Determine the cost of various energy efficiency measures, and calculate the value of them using various metrics. |

| Commercial Building Energy Audits and Analysis | | | |
|---|---|---|---|
| **Lighting Systems & Controls (30 Hours)** | | **HVAC 1, Fundamentals & Components (52 Hours)** | |
| Module Description | Learning Objectives | Module Description | Learning Objectives |
| Fundamentals of lighting systems and controls for energy auditors. Concepts of lighting, terminology, measurement tools, identifying energy efficiency opportunities, codes, standards. | Summarize terminology, physics and principles of lighting.<br>Identify and compare various types of lighting systems, including field identification and interpretation of nameplate data.<br>Measure illuminance and lighting intensity.<br>Describe the theory and operations of various lighting control systems.<br>Evaluate energy use by various types of lighting systems and identify opportunities for energy efficiency measures.<br>Calculate energy savings of energy efficiency measures and estimate their financial impact.<br>Apply relevant local, state and national codes, standards and regulations relevant to lighting system recommendations. | Fundamentals and concepts of HVAC with emphasis on types of equipment and conveyance. Principles of work, power and energy. Refrigeration cycle, psychrometric chart, load calculations, nameplate identification, media. | Describe the principles and concepts of work, power, and energy.<br>Describe the basic principles of thermodynamics and heat transfer.<br>Measure and calculate conversion of units, such as temperature, pressure, power, British Thermal Units (BTU), etc.<br>Analyze and interpret room conditions using the psychrometric chart and software such as Trace 700 or e-Quest.<br>Estimate various types of heating and cooling loads as applied to buildings, rooms, and mechanical systems.<br>Define the purpose of various heating, cooling, and conveyance equipment.<br>Identify various heating, cooling, and conveyance equipment in the field.<br>Interpret name plate data of various heating, cooling, and conveyance equipment. |

| Commercial Building Energy Audits and Analysis | | | |
|---|---|---|---|
| **HVAC 2, Systems & Efficiencies (52 Hours)** | | **Building Envelope Systems (30 Hours)** | |
| Module Description | Learning Objectives | Module Description | Learning Objectives |
| Configured HVAC systems types, system controls and identification of energy efficiency or conservation measures. | Describe and compare various types of air side systems such as single duct, dual duct, multi-zone, psychrometrics, terminal units, etc.<br>Describe and compare various types of water side systems such as steam, condenser water, hydronic, cooling and heating sources.<br>Describe the fundamentals of various controls of HVAC systems.<br>Evaluate energy conservation or efficiency measures of HVAC systems.<br>Calculate the energy efficiency or conservation coefficients such COP, EER and/or SEER.<br>Examine and evaluate various energy efficiency or conservation measures as applied to HVAC systems.<br>Calculate the amount of energy saved by implementing energy efficiency measures on both air side and water side systems. | Fundamentals of building envelope systems and how they can be used to control heat, light, sound, moisture, air movement. Benefits, challenges and applications of low-impact sustainable strategies for buildings. | Describe and distinguish the elements of the building envelope, including roof, walls, and glazing.<br>Describe and identify various building materials used in constructing commercial buildings.<br>Estimate the U-value, R-factor and C-value of various insulation materials.<br>Interpret relevant codes and code compliance related to existing buildings.<br>Describe the processes of air infiltration and natural ventilation into a building.<br>Describe various glazing types and relate them to thermal effects.<br>Compare and contrast various passive heating and cooling systems.<br>Evaluate the benefits and challenges of implementing various sustainability strategies. |

| Commercial Building Energy Audits and Analysis | | | |
|---|---|---|---|
| **Miscellaneous Building Systems (18 Hours)** | | **Demand Response for Energy Auditors (18 Hours)** | |
| Module Description | Learning Objectives | Module Description | Learning Objectives |
| Overview of types of facilities with high energy-use equipment, descriptions of equipment, plug load, vampire loads. Common energy efficiency opportunities. | Describe the types of facilities that contain high energy-use equipment, and evaluate why these are of interest to commercial building auditors.<br><br>Summarize the types of equipment in commercial kitchens, describe energy efficiency opportunities within commercial kitchens, and assess the challenges to implementing many of them.<br><br>Summarize the types of equipment in grocery stores, describe the energy efficiency opportunities within grocery stores, and assess the challenges to implementing many of them.<br><br>Summarize the types of equipment in offices, describe the energy efficiency opportunities within offices, and assess the challenges to implementing many of them.<br><br>Categorize equipment that contributes to vampire loads, and assess energy efficiency opportunities. | 5% of California generation is only utilized for 40 hours over a year. The power plants represented in this 5% are the dirtiest and most expensive in the state. We can eliminate the need for this generation through the use of demand response (DR) and load management. This class explores the applicability of various DR strategies including global temperature adjustment, global dimming for lights, pre-cooling and load control devices. DR rates and incentive types will be covered. Other topics include thermal storage and other load shifting systems, AutoDR, persistence and commissioning of these systems. | Assess the importance of load management and demand response in limiting peak load across the electrical grid.<br><br>Calculate and analyze load factor for various facilities as part of an effort to determine the impact of demand response or load shifting strategies.<br><br>Synthesize information on the variables that inform load management and demand response projects including utility rates, climate, facility type, facility usage patterns and occupant satisfaction.<br><br>Evaluate specific facilities for the potential application of various load management and demand response measures.<br><br>Integrate backup generators and alternative workforce schedules into demand response strategies, and consider the challenges these measures introduce.<br><br>Assess the value of automating demand response strategies to speed response time & eliminate errors. |

| Commercial Building Energy Audits and Analysis | | | |
|---|---|---|---|
| **Simulation Methods & Code Compliance (36 Hours)** | | **Professional Behavior for Energy Auditors (18 Hours)** | |
| Module Description | Learning Objectives | Module Description | Learning Objectives |
| California's energy and sustainability codes represent cost-effective levels of building performance and are a critical reference for energy auditors. This course explores the Building Energy Code (Title 24, section 6), Appliance Code (Title 20), and the Green Building Code (Title 24, section 11). The class will include modules on simulation tools that can be used for code compliance, analysis of the potential impact for specific EE and DR measures, verification of energy savings efforts. Simulation programs to be addressed include eQUEST, EnergyPro and Ecotect. Students will model specific EE measures or whole facilities with these programs as part of in-class exercises and homework assignments. | Describe the history of commercial energy efficiency regulation in California and related codes.<br><br>Describe the components of the Building Energy Efficiency Standards (Title 24, Section 6), the Appliance Code (Title 20), and the Green Building Code (Title 24, Part 11), and the building simulation requirements of each.<br><br>Compare various Building Energy Modeling Programs (BEMS), including Energy Pro, eQUEST, and Ecotect.<br><br>Create a building model using a BEMS such as eQUEST, and employ that model to measure and evaluate various energy efficiency and demand response measures. | Professional business behavior and communications for commercial building energy auditors. Includes written, telephonic and face-to-face communications, scheduling and conducting site visits with building owners/managers and their employees, basic report writing and presentations. | Appropriately communicate ideas verbally and in writing to both professional and technical personnel.<br><br>Research and present information clearly and professionally to clients and local agencies before and after site visits.<br><br>Compile and organize information for energy audits.<br><br>Identify, categorize, and prioritize energy efficiency measures and projects for implementation by facility managers, operators, and custodians.<br><br>Manage time and organize work effectively. |

| Commercial Building Energy Audits and Analysis | | | |
|---|---|---|---|
| **Measurement Tools & Verification of Savings Calculations (36 Hours)** | | **Energy Audit Report Writing (36 Hours)** | |
| Module Description | Learning Objectives | Module Description | Learning Objectives |
| Measurement and verification (M&V) is a quality assurance process for energy efficiency measures that have been implemented. Course covers how M&V relates to audit process, accepted standards, M&V planning, measurement boundaries, data collection tools and methods, savings calculations. | Describe the role of measurement and verification in the commercial building audit process.<br>Distinguish between different measurement boundaries, and describe the appropriate selection criteria for each.<br>Identify sources of data and appropriate measurement instruments.<br>Assess and apply different energy savings analysis methods.<br>Calculate actual energy savings based on data. | Capstone course for commercial buildings energy audit program. Concurrent enrollment with ENRG 63 Field Work in Commercial Energy Audit. Writing compelling and accurate technical report of audit findings for non-technical audience. Elements, formats, templates, structure, graphics. | Assess the purpose of the audit report, scope of work, and level of detail required for the report.<br>Organize information and create a plan for report writing.<br>Manage time effectively to meet client and employer needs.<br>Summarize audit findings and recommendations clearly and concisely.<br>Utilize tables, charts, and graphics to illustrate information and improve client understanding of findings.<br>Formulate prioritized recommendations that evaluate energy efficiency measure (EEM) recommendations in terms of energy savings and financial costs/ benefits to the client. |

| Commercial Building Energy Audits and Analysis | |
|---|---|
| **Fieldwork in Commercial Energy Auditing (105 Hours)** | |
| Module Description | Learning Objectives |
| Capstone course for commercial buildings energy audit program. Supervised field work experience or internship for a minimum 5 hours/week, plus weekly conferences with supervisor or faculty lead. Concurrent enrollment with ENRG 62 Audit Report Writing. | Create and manage effective professional relationships with clients and their employees, including promptness, responsibility and courtesy.<br>Plan and organize audit activities, including pre-audit information collection, site visit(s), and interviews.<br>Inspect and catalog various equipment at the client's facility, including heating, cooling, lighting, process and other system equipment.<br>Evaluate energy efficiency opportunities, calculate potential energy savings, and formulate recommendations for implementation.<br>Organize and set up power point presentation of findings to clients and team members.<br>Select appropriate standard terminology and format for technical report writing. |

HVAC Technician Commercial Quality Installation and Maintenance: Quality Installation / Quality Maintenance programs specifically dealing with the installation and maintenance of commercial heating, ventilation, and air conditioning/refrigeration systems

| **HVAC Technician Commercial Quality Installation and Maintenance: Commercial Package Unit Advanced Diagnostics** | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| This 1-day class is ideal for HVAC contractors who wish to learn more about diagnosing charge and air flow issues with commercial packaged units. A portable commercial package unit is used which is capable of simulating multiple faults. Instructors can control and simulate faults for technicians to diagnose and correct. This course is ideal for contractors who perform maintenance on commercial packaged units. | Describe how comfort is achieved through proper installation and operation of an HVAC System within an instructor guided exercise.<br><br>Describe how the use of load calculations affects HVAC equipment performance and occupant comfort within an instructor guided exercise.<br><br>Describe how measurement and verification of an HVAC system insures occupant comfort within an instructor guided exercise.<br><br>Practice selling quality installations within a classroom/lab exercise. | Refrigerant Side Analysis<br><br>Air Flow Side Analysis<br><br>Refrigeration Side Fault Detection and Practice<br><br>Air Side Fault Detection and Practice | **Intermediate level class, suitable for Community Colleges,** designed for HVAC technicians who regularly perform maintenance on commercial HVAC package units:<br><br>Architect / Designer, Bldg Dept Inspector, Bldg Dept Plan Checker, Building Operator, Building Owner, Commissioning Agent, Contractor – Electrical, Contractor – General, Contractor – Home Performance, Contractor – HVAC/Mechanical, Contractor – Insulation, Contractor – Plumbing, Contractor – Pool, Contractor – Roofing, Contractor – Window, Developer, Distributor/Supplier, Energy Consultant, Engineer – Electrical, Engineer – HVAC/Mechanical, Facilities Manager, HERS Rater, Interior Designer, Landscape Architect, Lighting Designer, Policy Maker, Rater – Existing Homes, Rater – New Homes, Realtor, Residential Builder, Residential Remodeler, Solar/PV Designer |
| Materials Provided | Reference designs and consultation for training equipment (e.g., package unit training prop) | | |

| HVAC Technician Commercial Quality Installation and Maintenance: Commercial Quality Maintenance and Installation of Economizers | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| This 1 day class will combine interactive classroom lessons with hands on training using a state-of-the-art rooftop unit built specifically for training purposes. We will discuss the importance of indoor air quality, ventilation requirements, and energy savings in order to provide a background for our analysis of economizers. The class will dive into the details of how an economizer works and how technicians can diagnose problems in the field. Finally, we will discuss best practices for economizer component selection and installation. | Explain the importance of indoor air quality for occupants<br>Explain the energy impact of an economizer.<br>List the key components of an economizer.<br>Determine the root cause of an economizer failure.<br>Calculate the minimum ventilation rate for a commercial building. | Indoor Air Quality<br>Economizers<br>History of Economizer Controllers<br>Economizer Functional Testing<br>Hands on training – Functional Testing<br>Economizer Installation<br>Code Compliance & Acceptance Testing<br>Ventilation Calculation Shortcuts | **Intermediate level class, suitable for Community Colleges,** designed for HVAC technicians who regularly perform maintenance on commercial HVAC package units:<br>Architect / Designer, Bldg Dept Inspector, Bldg Dept Plan Checker, Building Operator, Building Owner, Commissioning Agent, Contractor – Electrical, Contractor – General, Contractor – Home Performance, Contractor – HVAC/Mechanical, Contractor – Insulation, Contractor – Plumbing, Contractor – Pool, Contractor – Roofing, Contractor – Window, Developer, Distributor/Supplier, Energy Consultant, Engineer – Electrical, Engineer – HVAC/Mechanical, Facilities Manager, HERS Rater, Interior Designer, Landscape Architect, Lighting Designer, Policy Maker, Rater – Existing Homes, Rater – New Homes, Realtor, Residential Builder, Residential Remodeler, Solar/PV Designer |
| Materials Provided | Reference designs and consultation for training equipment (e.g., package unit training prop) | | |

| HVAC Technician Commercial Quality Installation and Maintenance: Demand Control Ventilation (DCV) and Variable Speed Fans | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| In order to better control commercial buildings during occupied periods, and comply with new Title 24 2013 code requirements, this course will provide contractors with a full understanding of demand control ventilation, and variable speed fan control strategies. PG&E resource program rebates will also be addressed as they apply to DCV and variable speed fan control. | Students will be able to understand and describe what demand control ventilation is and how it saves energy.<br>Students will be able to understand and describe what variable air volume is and how it saves energy.<br>Students will be able to describe and understand the logic of economizer, DCV, and VAV operation within a commercial HVAC packaged unit.<br>Students will practice the steps for installing and setting up a DCV/VAV retrofit through a group exercise.<br>Students will adjust the operating settings for a DCV/VAV system through a group exercise. | -Background Roof Top Package Units and PG&E Quality Maintenance Program<br>-Indoor Air Quality Basics<br>-Economizer Basics<br>-Variable Air Volume (VAV) Basics<br>-How It Works<br>-Energy Savings<br>-Installation and Testing<br>-Demand Control Ventilation<br>-How It Works<br>-Energy Savings<br>-Installation and Testing<br>-Hands on Training<br>-DCV and VAV Installation | This is an intermediate level class for HVAC technicians who regularly work on commercial package unit equipment. |
| Materials Provided | Reference designs and consultation for training equipment (e.g., package unit training prop) | | |

| HVAC Technician Commercial Quality Installation and Maintenance: Small Commercial QI ACCA Manual N | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| This full day training class is designed to introduce HVAC Contractors, General building Contractors, and Mechanical Engineers to the process of sizing, designing and installing small Commercial HVAC package unit systems. This class includes three specific components: 1. Classroom instruction of the building science affecting equipment capacity and building loads; 2. Hands on training in the use of Wrightsoft™ to size small commercial loads; 3. Classroom instruction on the proper sizing procedures in ACCA Manual CS, and California Title 24 Ventilation Regulations. | Students will be able to describe the fundamentals of building science as it applies to commercial HVAC systems within an instructor guided exercise.<br><br>Students will be able to describe the process of sizing and selecting commercial HVAC package systems within an instructor guided exercise.<br><br>Students will be able to size and select a commercial package HVAC system using the ACCA approved software within an in instructor guided classroom exercise.<br><br>Students will be able to describe the fundamentals of Manual CS as it applies to commercial package HVAC systems within an instructor guided exercise.<br><br>Students will be able to describe the fundamentals of the California Title 24 regulations as they apply to outside air ventilation within an instructor guided exercise. | Building Science Principles<br><br>Wrightsoft program<br><br>Introduction<br><br>Instructor Guided Exercises<br><br>Building Loads<br><br>Title 24 Ventilation<br><br>Requirements<br><br>Student Practice Exercise<br><br>Building Loads | **Advanced level course material, suitable for university programs:**<br><br>Architect / Designer, Bldg Dept Inspector, Bldg Dept Plan Checker, Building Operator, Building Owner, Commissioning Agent, Contractor – Electrical, Contractor – General, Contractor – Home Performance, Contractor – HVAC/Mechanical, Contractor – Insulation, Contractor – Plumbing, Contractor – Pool, Contractor – Roofing, Contractor – Window, Developer, Distributor/Supplier, Energy Consultant, Engineer – Electrical, Engineer – HVAC/Mechanical, Facilities Manager, HERS Rater, Interior Designer, Landscape Architect, Lighting Designer, Policy Maker, Rater – Existing Homes, Rater – New Homes, Realtor, Residential Builder, Residential Remodeler, Solar/PV Designer |
| Materials Provided | Reference designs and consultation for training equipment (e.g., package unit training prop) | | |

| HVAC Technician Commercial Quality Installation and Maintenance: Small Commercial QI ACCA Manual Q-T Duct Design | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| This full day training class is designed to introduce HVAC Contractors, General Building Contractors, and Mechanical Engineers to the process of duct design and register selection when installing small Commercial HVAC systems. This class includes four specific components; 1. Classroom instruction of the ACCA Duct Design procedure; 2. Classroom instruction on effects of CFM, velocity and pressure on duct desgins and general airflow terminology; 3. Duct sizing practice exercises; 4. Register selection and placement. | Students will be able to describe the process for designing duct systems for commercial HVAC system installations within an instructor guided exercise.<br><br>Students will be able to describe the process for selecting registers for commercial HVAC system installations within an instructor guided exercise.<br><br>Students will be able to design a duct system and select registers for a commercial HVAC system within an instructor guided exercise.<br><br>Students will be able to describe the effect of CFM within the design of a commercial HVAC package unit system within an instructor guided exercise.<br><br>Students will be able to define various air flow terms related to HVAC commercial package unit systems within an instructor guided system. | Air flow terminology and the Duct Design Process<br><br>Register Selection<br><br>Effect of CFM on Duct Design<br><br>Instructor Guided Duct Design Exercises | **Advanced level course material, suitable for university programs:**<br><br>Architect / Designer, Bldg Dept Inspector, Bldg Dept Plan Checker, Building Operator, Building Owner, Commissioning Agent, Contractor – Electrical, Contractor – General, Contractor – Home Performance, Contractor – HVAC/Mechanical, Contractor – Insulation, Contractor – Plumbing, Contractor – Pool, Contractor – Roofing, Contractor – Window, Developer, Distributor/Supplier, Energy Consultant, Engineer – Electrical, Engineer – HVAC/Mechanical, Facilities Manager, HERS Rater, Interior Designer, Landscape Architect, Lighting Designer, Policy Maker, Rater – Existing Homes, Rater – New Homes, Realtor, Residential Builder, Residential Remodeler, Solar/PV Designer |
| Material Provided | Reference designs and consultation for training equipment (e.g., package unit training prop) | | |

| HVAC Technician Commercial Quality Installation and Maintenance: Small Commercial QI Advanced Manual N | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| This full day training class is designed to introduce HVAC Contractors, General building Contractors, and Mechanical Engineers to the process of sizing, designing and installing small Commercial HVAC Systems. The training class includes two specific components; 1. Review of all objectives and principles covered in the first two courses of this series; 2. Hands on software exercises guided by the instructor to verify students can properly design an HVAC package unit system for quality installation, as well as properly design the duct system. | | Review all principles of equipment selection and duct design for an HVAC package unit system.<br><br>Hands on HVAC equipment selection and duct design within an instructor guided exercise using the Wrightsoft™ software. | **Advanced level course material, suitable for university programs:**<br><br>Architect / Designer, Bldg Dept Inspector, Bldg Dept Plan Checker, Building Operator, Building Owner, Commissioning Agent, Contractor – Electrical, Contractor – General, Contractor – Home Performance, Contractor – HVAC/Mechanical, Contractor – Insulation, Contractor – Plumbing, Contractor – Pool, Contractor – Roofing, Contractor – Window, Developer, Distributor/Supplier, Energy Consultant, Engineer – Electrical, Engineer – HVAC/Mechanical, Facilities Manager, HERS Rater, Interior Designer, Landscape Architect, Lighting Designer, Policy Maker, Rater – Existing Homes, Rater – New Homes, Realtor, Residential Builder, Residential Remodeler, Solar/PV Designer |
| Material Provided | Reference designs and consultation for training equipment (e.g., package unit training prop) | | |

| Lighting Technology: Program-Level Information | | | |
|---|---|---|---|
| Program Description | Learning Objectives | Syllabus | Target Audience |
| 80% of commercial and residential buildings have inefficient lighting. California Title 24 energy code requires energy efficient lighting for new construction and retrofits.<br><br>With the advent of new technologies, the implementation of energy efficient lighting will require specialized knowledge and skills at the intersection of Design, Energy, and Technology.<br><br>This program is taught in series of workshops, for multi-layered learning and hands-on equipment exposure.<br><br>This program will integrate conceptual with practical skills, engaging students in projects and discussions with panel of instructors. | To provide the practical skills and the knowledge of "how to do it" in lighting.<br><br>To help students learn new lighting technologies such as microchips LED lighting, wireless controls, lighting apps, and networks.<br><br>To bring integrated thinking for implementing the multi-layers of energy efficient lighting. | Program consists of 5 modules:<br>• Hands-on Lighting Design<br>• Lighting Code Title 24 and Regulations<br>• Hands-on LED Technology<br>• Hands-on Lighting Controls<br>• Project: Lighting Retrofit A-Z<br><br>*All modules have similar structure – 20% is the conceptual teaching combined with a site tour to "see"; 80% is the hands-on equipment, lighting mock-ups and demos, and doing spaces vignettes as individual or group projects<br><br>Note: A Lighting Test can be taken at the end of the 5 modules for a certificate. | For College students that are interested in technical disciplines such as Electrical, Efficiency – Sustainability, Environmental, and Building Technologies and Integration.<br><br>Note: These modules can work in conjunction with PG&E's Pacific Energy Center "Building Sciences" courses. |
| Materials Provided | This is a collaborative program with lighting manufacturers, which have initially provided Pacific Energy Center instructors with lighting equipment necessary for the workshops.<br><br>For the long term, it is recommended that colleges form a coalition with lighting manufacturers to facilitate periodic updates of lighting teaching equipment, and to train college faculty to become familiar with cutting edge lighting technology. Colleges may have to purchase lighting equipment in order to make it permanently available for teaching. | | |

| LEW Design (Light + Efficiency + Well-being): LED Lighting for Healthier Living | | | |
|---|---|---|---|
| Module Description | Learning Objectives | Syllabus | Target Audience |
| Light continuously interacts with people, influencing human perception, impacting the body functions and influencing our emotional state. This course helps the student gain insight into the impact lighting has on our healthiness and well-being, and it provides simple steps for how to implement.<br><br>With the advent of LED new technology, which is also energy efficient and has a long life span, our interaction with lighting is more direct and how we light our environment is changing very quickly. Soon the old fixtures—incandescent, fluorescent, halogen, metal halide; will be replaced by LEDs that will dominate the market and become the exclusive lighting source.<br><br>You will see new, innovative ways of using lighting. This course will provide students with an understanding of how to create healthy alternatives for their living and working environments.<br><br>What we learn in this course conceptually, will be then applied to real life situations. | To bring awareness to the general public of the connection between light and health.<br><br>To help people create and inhabit healthier environments in their daily lives.<br><br>To introduce people to simple and self-made healthy lighting approaches. | Lighting Basics: different sources of light and distinct qualities of light. Hands-on LED. Homework: Research on “inspiring” uses of light. Paper: “Use of Light that is Inspiring”.<br><br>Lighting and Perception: techniques for perceptual changes and sensory stimulation. Hands-on smart controls and LED color tuning. Homework: Experiment with perceptual changes of objects done with lighting. Demo in class.<br><br>Lighting and Health: interaction with human systems - visual, circadian, perceptual. Hands-on lighting for the needs of different people—old age and young, healthy and sick. Homework: Research on Light and Health. Paper: “Lighting Impact on Health”.<br><br>Design inspired by Nature: Biomimicry, daylight and bio-dynamics, creating natural patterns and settings for healthy and regenerative environments. Hands-on lighting modulation. Homework: Observe daylight, and write a narrative for “Lighting sequences of change”.<br><br>Final Project – Case Studies for Healthy Lighting, design and demo in class for hospital, residential, and other areas by your choice. Present and defend your work in class. | The series is intended for both the general public and design professionals. It is an elective course for students in the UC Berkeley Extension Certificate Program of Interior Design & Interior Architecture. |
| Materials Provided | Lectures using slides, graphs and illustrations; demonstrations in state-of-the-art learning lab at the Pacific Energy Center, San Francisco; videos; in-class review of homework assignments; case studies will all be learning tools | | |

# Appendix B
# Solicitation of Proposals

# Expansion of PG&E Energy Center Training
# Into
# Public Postsecondary System

## Statement of Purpose

Pacific Gas and Electric Co. ("PG&E") operates training centers that offer courses in all aspects of energy efficiency, including the design, installation, commissioning, operation, and maintenance of energy efficient lighting, heating, ventilation, air conditioning, and refrigeration systems in commercial and industrial buildings. To expand the reach of these programs, PG&E is offering curriculum and expertise in four topic areas to colleges in the California public postsecondary system (the University of California, California State University, and California Community College systems – the "colleges") in its service territory. The four topic areas are:

- Building Science Fundamentals for Energy Efficiency
  - Introduction to fundamental building energy efficiency concepts such as heat transfer, airflow management, moisture management, and solar geometry for improved understanding of how building design and construction techniques affect energy use
  - Impacted occupations (sample): Architect, Designer, Engineer, Construction Manager, Electrician, Plumber, Sheet Metal Worker, HVAC Installer, General Contractor, Energy Auditors, Building Inspectors

- Commercial Building Energy Audits and Analysis
  - Explore concepts of energy auditing, energy measurement, analyzing building envelope, assessing building mechanical systems, identifying opportunities for energy efficiency, calculating energy use and savings, energy modeling tools, and business development skills for writing audit reports
  - Impacted occupations (sample): Energy Auditor, Building Commissioning Specialist, Designer, Engineer, Construction Manager, General Contractor, Building Inspector

- HVAC Technician Commercial Quality Installation and Maintenance (QI/QM)
  - QI/QM programs specifically dealing with the installation and maintenance of commercial heating, ventilation, and air conditioning/refrigeration systems
  - Impacted occupations (sample): HVAC Installer, HVAC Technician, Sheet Metal Worker, Stationary Engineer, Energy Auditor

- Lighting Technology and LEW Design (Light + Efficiency + Wellbeing)
  - Lighting technology modules include Lighting Design, Title 24 Code, Lighting Technology, Lighting Controls, and Lighting Retrofits. (Note: These require schools to have an equipped lighting lab or manufacturers' product samples)
  - LEW Design (Light + Efficiency + Wellbeing) will consist of five new three-hour modules, which will be completed in Q1 2015. (These can be taught with less equipment)
  - Impacted occupations (sample): Architect, Designer, Electrician, Energy Auditor, Lighting Specialist

PG&E is soliciting applications from the colleges for adoption or adaptation of the curriculum. Curriculum and training materials will be provided with subject matter expertise to assist the colleges in incorporating the curriculum into new or existing college programs in related program areas. Interested colleges will provide information on how the curriculum will be adopted or adapted. PG&E will evaluate the responses to the solicitation to determine which responses best afford the greatest program expansion opportunities and award curriculum to as many colleges as the availability of expertise allows. It is anticipated that as many as eight colleges will receive awards. Colleges receiving awards will demonstrate a commitment to delivering the curriculum to students with high potential for putting the training into practice. Curriculum will be provided either open source through no-fee Creative Commons Attribution-ShareAlike licenses, or as reference material that may be adapted but could be subject to licensing arrangements that will be specified in the final agreements with receiving Colleges. Colleges may consider PG&E's contribution of curriculum and subject matter expertise as “in kind” contributions for purposes of grant applications, but PG&E is not contributing money or equipment as part of this solicitation.

Details on the curriculum offering in each of the four topic areas can be found in Appendix A to the Heads of Agreement document that defines the roles and responsibilities of the parties, and is incorporated into the solicitation.

## Eligibility

Curriculum is being made available to California public postsecondary institutions: University of California colleges, California State Universities, California Community Colleges, including continuing education programs, in the PG&E service territory. One application is required per priority topic area for which your institution is seeking an award. Identify the specific program within your institution that is making this application.

## Deadline and Submission

The deadline for applications is 5 pm PST February 27, 2015. Applications may be submitted electronically or by hard copy (electronically and PDF preferred, but no preferential treatment will be given regardless of the form of transmission). Brevity in responses is appreciated where possible. Submit electronically to:

Lisa Shell at L1sb@pge.com and CC Brad Hurte at bhurte@workforceincubator.org

Submit hard copy to:

Lisa Shell
851 Howard Street
San Francisco CA 94103

If submitting hard copy, please email notification to bhurte@workforceincubator.org before the deadline.

Note: It is not necessary to complete the Heads of Agreement section; only complete the Application section.

## Application

1. Applicant Information

   Name of Institution:

   Address:

   Website:

   Contact Name:

   Title:

   Email:

   Phone Number:

2. What curriculum is being applied for

   Indicate which of the four priority topic areas to which this application applies. Select all that apply.

   - o Building Science Fundamentals for Energy Efficiency
   - o Commercial Building Energy Audits and Analysis
   - o HVAC Technician Commercial Quality Installation and Maintenance
   - o Lighting Technology and LEW Design (Light + Efficiency + Wellbeing)

3. Where curriculum would be used

   Identify new or existing educational programs. Provide course descriptions, syllabuses, or any other material that would aid PG&E in evaluating how well the curriculum offered would match and enhance the existing or new program.

   a. Name of Course or Courses

   b. Program(s) within which these courses are taught

   c. Indicate whether courses are existing, being developed, or planned

   d. Attach the syllabus for each course

   e. Indicate website for the program(s) or department(s) within which each course is taught

   f. Provide other information that will aid PG&E in evaluation

4. How PG&E curriculum would be used

   Provide any detail on how you think the PG&E curriculum would enhance your new or existing program. For example, describe if and how students will receive experiential learning in relation to this curriculum. Will they and their instructor have access to campus facilities and equipment for purposes of observation and evaluation of energy uses and application of energy efficiency measures?

   a. Topic Areas within your courses where PG&E content will be beneficial

   b. What student outcomes are likely to be enhanced by PG&E content

   c. Applicability to student success

      I. Employment readiness

      II. Preparation for industry-recognized certification

d. Supporting elements currently in place

I. Lab facilities (describe)

II. Experiential learning outside the lab/classroom (describe)

5. Enrollment and Completion

For existing courses, indicate enrollment and successful completions of last 3 semesters/quarters of the programs' offering; for new courses, provide an estimate of enrollment per term.

a. Enrollment (for each course)

b. Course completions

c. Related program completion in latest term

I. Certificates

II. Degrees

a. Third-party certifications in latest term (list types and numbers achieved by type)

b. Indicate articulation agreements currently in place for related programs

I. High school/ROP/other secondary schools

II. Community college

III. University

IV. Other (please specify)

6. Labor Market Demand

a. Target Occupations for each course

b. Labor market demand for each Target Occupation

c. Source of labor market demand data

d. Major employers for Target Occupations

7. Supporting Institutions and Programs

Identify partnerships with industry associations, industry collaboratives, WIBs, or other supporting organizations for recruitment and subsequent placement of students into related occupations.

- Industry Associations
  - Name(s)
  - Nature of relationship
  - How long in partnership
- Industry Collaboratives
  - Name(s)
  - Nature of relationship
  - How long in partnership
- Workforce Investment Boards (WIBs)
  - Name(s)

- o Nature of relationship
- o How long in partnership
- Other
  - o Name(s)
  - o Nature of relationship
  - o How long in partnership

8. Additional Program Support Available

Identify other sources of support and funding that will augment or accelerate the integration of PG&E curriculum into your programs.

a. Applicable Grants for programs receiving PG&E content

I. Names of grants currently in place

II. How each grant will support integration of PG&E content

a. Other sources of support for programs receiving PG&E content

- Names of programs currently in place
- How will each program will support integration of PG&E content

9. PG&E support required for implementation

Identify specific needs for support for adoption/adaptation of the curriculum beyond that which has been identified in this application.

10. Other supporting data

Provide any other information that you believe supports your application; tell us what we haven't asked that lends support to an award for your institution.

## Heads of Agreement

1. Scope

These heads of agreement, i.e., non-binding outline of main issues relevant to a tentative partnership agreement are between Pacific Gas and Electric Co. (PG&E) and_____(Awardee), and outlines the general understanding of terms in a curriculum transfer from PG&E to Awardee. PG&E is providing curriculum, training materials, and support expertise as specified in Appendix A to Awardee, with the understanding that Awardee will be incorporating said curriculum into its_____ program, beginning _____. This curriculum is being awarded based on Awardee's response to a solicitation from PG&E in Winter of 2015; Awardee's response is attached in Appendix B.

2. Definitions

As needed.

3. Terms and Conditions

PG&E providing curriculum and expertise for adoption/adaptation; PG&E not providing funding or equipment. Colleges awarded agree to adapt/adopt per plans spelled out in solicitation response. Curriculum may be provided in two ways, contingent on the curriculum being adopted/adapted:

- Through a no-cost license consistent with open source Creative Commons Attribution-ShareAlike licenses (www.creativecommons.org); and/or
- As copyrighted material that may be referenced in the development of original curriculum, but may be subject to 3rd party license considerations – PG&E will make best efforts to liaise with copyright holders in such cases.

4. Program Specifics

Awardee is receiving curriculum, training materials, and support expertise for adaptation of the curriculum in the topic area_____, specified in Appendix A, for adaptation in its program area_____as specified in its application (Appendix B).

5. PG&E Responsibilities

PG&E will provide curriculum as specified in Appendix A, and support expertise for adaptation of the curriculum to Awardee, also as specified in Appendix A. PG&E is not providing funds, material, personnel, or equipment beyond what is specified in Appendix A.

PG&E agrees to provide attribution to Awardee's programs in PG&E marketing materials, which can include its web site, training center course advertising, outreach to training center mailing lists, and other such promotional methods as may be beneficial to Awardee's program and PG&E's goals for this curriculum expansion program.

6. College Responsibilities

Awardee is adapting curriculum per its application in Appendix B. Awardee will make best efforts to implement the curriculum award by the term specified in its application, and recognizes that failure to do so bears on PG&E's ability to allocate expert time, which was a consideration in the award. Awardee will notify PG&E immediately upon it recognizing any barrier to implementing the curriculum per its application to give PG&E an opportunity to seek alternative institutions to adapt the curriculum; curriculum will not be withdrawn, but PG&E may not have the expert resources to support adoption by Awardee in such cases.

Student and faculty access to campus facilities and equipment is encouraged in order to provide students with real-world exposure to energy efficiency related concepts and systems. A secondary benefit to participating institutions is that such student/faculty access may result in campus energy savings and operating cost reductions.

Consistent with the terms of the Creative Commons Attribution-ShareAlike license, materials are to be accompanied by the PG&E logo (as appropriate) and the following statement: [Segments of] this [program/course/presentation] are funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission.

7. Anticipated Outcomes

_____curriculum adopted into_____program by_____term; enrollment of _____students in that term (or those terms, specified in Awardee's application, Appendix B); successful completion and placement of_____(if specified in Awardee's application).

8. Metrics

Awardee will report on outcomes per item 7 (above) to PG&E once per term for 4 terms or while the curriculum is being used, whichever is greater, preferably no later than 4 weeks after end of term. Reports at minimum will include actual versus anticipated results, but may include any other information that supports the success of the program or indicates where the program has failed to generate anticipated outcomes for purposes of future program improvement and sustainability – PG&E wishes to collaborate with the schools to develop best practices for future curriculum transfer. Reports will be made to:

Lisa Shell

851 Howard Street
San Francisco CA 94103
L1sb@pge.com

9. Timeline

PG&E will make best efforts to support the distribution of curriculum and supply of supporting expertise as specified in Appendix A according to Awardee's schedule as specified in its application, Appendix B.

10. Disclaimer

This Heads of Agreement does not constitute or imply a contract between the parties. Both PG&E and Awardee are entering into a mutually beneficial transfer of curriculum – Awardee to enhance its curriculum and PG&E to enrich the skill level of workers to help achieve legislated energy efficiency goals and mandates. Where curriculum includes material that is not copyrighted by PG&E, Awardee may reference curriculum in the development of original works; alternately, PG&E will liaise with copyright holder to facilitate licensing agreements between copyright holder and Awardee. This Heads of Agreement is expressly to indicate a general agreement by both parties of best efforts to achieve that transfer successfully, and to identify what such a successful transfer would look like. No claim of harm or liability can arise from either party failing to perform according to PG&E's solicitation or Awardee's application.

# Appendix C
# Collaborative Model:

# Sacramento
# Construction and Energy Sectors Initiative

# Sacramento Construction & Energy Sectors Initiative

## *A Regional Workforce Development Coalition to Improve Links Between Education, Workforce Agencies and Employers*

# Executive Summary

**April 2015**

In early 2014 a broad range of Sacramento Region workforce development stakeholders were convened by Rick Larkey, Director of Workforce for the North State Building Industry Foundation. The impetus for formation of this coalition emerged from a regional industry forum hosted by PG&E's Energy Workforce Sector Strategy (EWSS) Project. Participants in the initiative represent sector employers, labor and apprenticeship programs, colleges and universities, school districts, Workforce Investment Boards (WIBs), and utilities.

Over the past year it has grown to include a broad array of stakeholder organizations from industry, labor, education, and workforce development agencies. They meet regularly to address workforce needs and to coordinate their respective and joint activities, including new programs (e.g., 107 Linked Learning Pathways funded by California Career Pathways Trust grants).

**Purpose:** To create a collaborative organization of stakeholder entities to facilitate improved communication, coordination, and alignment of respective efforts to meet the workforce needs of industry and provide gainful employment for students and job seekers. Also, to pool resources and integrate efforts to fund and sustain workforce programs. This is meant to provide a regional umbrella organization to facilitate and support local workforce efforts.

**Goal –** To gather regional resources to implement the following on a regional basis:

- Communicate about who is doing what
- Coordinate work-based learning efforts, industry certifications, curriculum development, and developing outcome-based metrics
- Provide resource development for local and regional programs

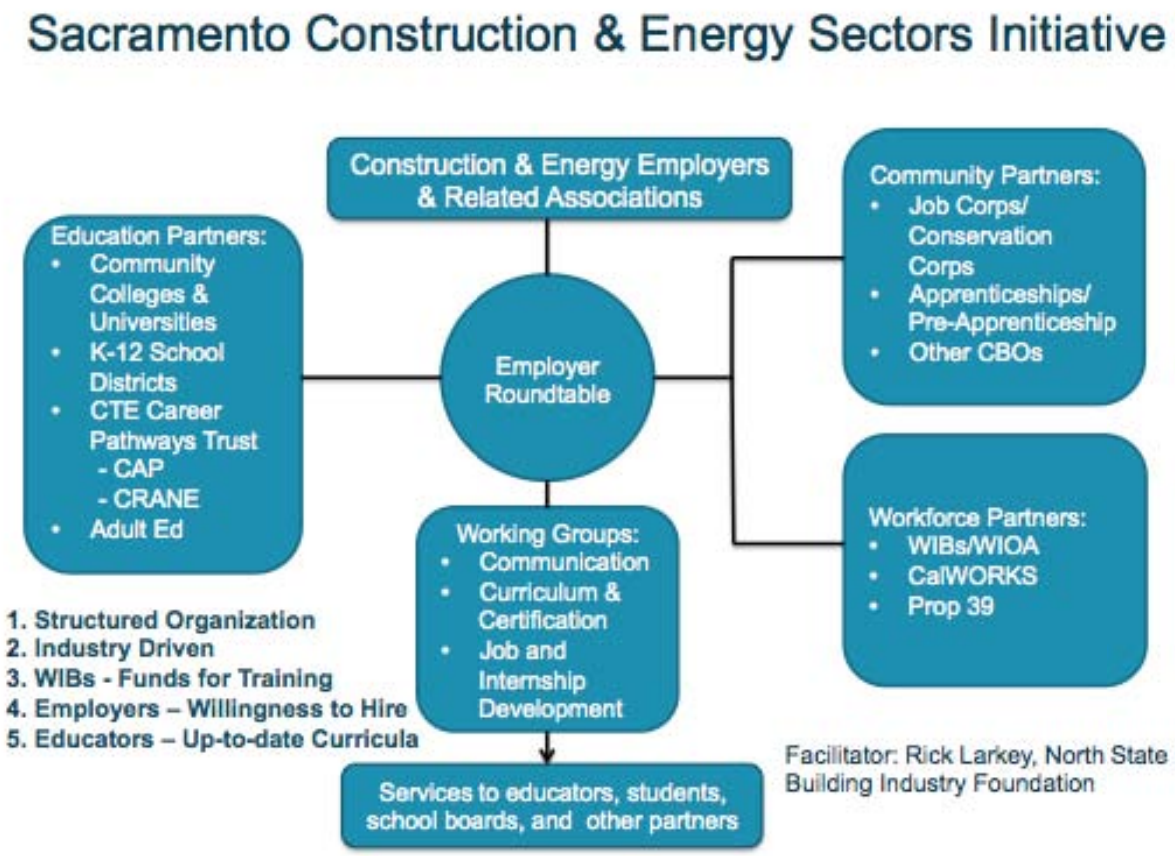
**Scope and Structure:** This consortium is organized as a six county regional effort (e.g., Sacramento, El Dorado, Placer, Yolo, Yuba, Sutter). It is organized around a central Employer Roundtable with linkages to

employers, industry associations, educators, and workforce training and development resources. Three working groups (e.g., Communication, Curriculum & Certification, and Job and Internship Development) meet regularly and provide services to the various stakeholder groups.

**Working Groups Formed:**

- Communications
- Curriculum & Certification
- Job and Internship Development

**Organization Structure:**




**Benefits of This Regional Approach:**

1. It is a structured organization led by an industry champion with support staff.
2. It is industry driven.
3. Workforce Investment Boards (WIBs), which have funds for training and job placement, are actively engaged.
4. Employers have shown a willingness to hire.
5. Educators are updating curricula to better meet industry needs.