High Performance Building Systems Technologist
Job Task Analysis Summative Research Report
July 2018

Developed for

Shoreline Community College
Clean Energy Technology Program

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Prepared by:

VIVIAN PALMER CONSULTING:
Vivian Palmer, CEO
(248) 882-3368
www.vivianpalmer.com

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PROJECT OVERVIEW

The Clean Energy Technologist will be a new job title and Shoreline Community College is seeking to identify skills a technologist will need to be competitive in today's workforce. Shoreline would like to elevate and align its current certificate and degree programs to address the professional-technical educational skills for a technologist position. The new program will address curriculum and more specifically software tools—which requires a sophisticated skillset—to achieve the professional and technical education requirements for High-Performance Building Systems technologists.

The software tools that will be integrated into the High-Performance Building Systems technologist (HPBS) curriculum are:

- Building Information Modeling (BIM)
- Building Energy Modeling (BEM)
- 2D CAD-3D Modeling (CAD-3D)
- Energy Dashboarding-Controls (EDMC)
- General Productivity Software (Spreadsheets, Presentation, Word Processing)

These tools are ubiquitous in the professional practice and are critical support to the activities of the field. In addition, the use of the software will be integrated throughout the program and used to reinforced using the project-based learning model.

PROJECT GOAL/OBJECTIVE

The goal of this research project was to provide information to the Shoreline Community College to enhance the curriculum for the Clean Energy Technologist Program. The redesigned program curriculum will include analyzing and designing maintenance and operations systems of commercial buildings and exploring the potential for a certification complemented a two-year associate degree.

Our analysis included working with industry experts to make them aware of the mission and strategic focus of Shoreline's goals and objectives. Shoreline understands the challenges local business and industry stakeholders have experienced with hiring technicians with appropriate technical preparation and wants to establish on-going collaboration between the college and these key stakeholders.

GOAL: Identify and define skill standards and curriculum for a Clean Energy Technologist.

Shoreline's leadership wants to obtain an increased understanding of the industry needs including industry structure, data on the profession, and details on existing certificates, and certifications.

OBJECTIVE: Develop the curriculum necessary for a Clean Energy Technologist workforce by 2018.

This process started with the creation of an advisory board executed by Louise Petruzzella, Director, Clean Energy Technology in 2016. This board includes representatives from the college, regional business and industry subject matter experts, as well as public sector stakeholders. The current advisory board focuses on key issues such as critical skill requirements, recognition of HPBT as a career pathway, certification strategy, and re-training requirements for the existing workforce.

SUMMARY OF PRIMARY RESEARCH

The primary research began with the solicitation for Focus Group participants. The Focus Group were established to analyze the job task, knowledge and skills for two (2) High Performance Building Systems (HPBS) jobs – Clean Energy Analyst and Clean Energy Designer. Shoreline's leadership lead the task to identify potential candidates to assure the in-depth experience of the industry experts. The participants were invited to participate via an e-mail that provided an overview of the project and the DACUM Job Task Analysis process. This e-mail was developed by Palmer Consulting and sent to participants as well as the internal subject matter experts at Shoreline. In total, twelve (12) recruiting e-mails were sent, resulting in eight (8) confirmed participants for three (3) Focus Group meetings.

This report provides results of the analysis and will form the basis for a subsequent industry validation, where the group of industry practitioners and subject matter experts evaluated a list of job-related tasks, skills, and competencies. This group validated the identified tasks and weighting factors to accurately represent two (2) High Performance Building Systems (HPBS) jobs – Clean Energy Analyst and Clean Energy Designer. This analysis also provided an opportunity for the group to identify any missed tasks or any that were included erroneously.

Shoreline begin the Job Task Analysis in August 2017. The Principal Investigator (PI) solicitated the services of a consultant to complete the task outlined on the following timeline.

PROJECT TIMELINE

August 2017

- Compiling resources and data related to project goal and objectives
- Reviewed objectives for Focus Group meetings
- Developed project plan for Job Task Analysis
- Established a prospective Business and Industry participants for Focus Group

September 2017

- Established list of internal stakeholders for Focus Group meetings
- Finalized project objectives and data resources analysis
- Developed preliminary resources for Job Task Analysis data/questionnaires
- Research/Review Department of Energy Job Task Analysis

October 2017

- Established Job Task Analysis questionnaire data resources
- Finalized preliminary focus group participant lists

November 2017

- Develop Communication tools for Focus Group participants
- Review/compile draft Job Task Analysis questionnaire data
- Review/compile draft Job Task Analysis questionnaire data for Clean Energy Analyst

December 2017

- Develop draft communications for Focus Group Meeting participants via EventBrite
- Review final Job Task Analysis questionnaire for Clean Energy Analyst

January 2018

- Develop/distribute communications for Focus Group Meeting #1 participants via EventBrite
- Focus Group Meeting #1 – Clean Energy Analyst Job Task Analysis
- Review/compile Focus Group Meeting #1—questionnaire data
- Review final Job Task Analysis questionnaire data for Clean Energy Designer Job Task Analysis

February 2018

- Develop/distribute communications for Focus Group Meeting #2 participants
- Focus Group Meeting #2
    - Clean Energy Analyst Job Task Analysis
    - Clean Energy Designer Job Task Analysis
- Analyze/compile Job Task Analysis questionnaire data for Clean Energy Analyst

March 2018

- Develop/draft communications for Focus Group Meeting #3 participants
- Focus Group Meeting #3 – Clean Energy Designer Job Task Analysis
- Analyze/compile Job Task Analysis questionnaire data for Clean Energy Designer

April 2018

- Develop Curriculum Outline and Job Description for Clean Energy Technologist (Analyst/Designer)
- Focus Group Participants complete project survey
- Develop draft Job Task Analysis Survey Monkey/Google Form survey tool for business and industry feedback

May 2018

- Develop draft Comprehensive Summative Report

June 2018

- Final Comprehensive Summative Report

FOCUS GROUP MEETINGS

Meeting #1: Consisted of an introduction to the DACUM process. The trained DACUM facilitator explained the job task analysis process and provided the Focus Group participants with duty and task statement definitions. A duty/competency reflects a large area of work for a specific profession; multiple tasks describe how to perform each duty/competency.

The presentation then shifted to a discussion about Clean Energy Analyst position, more specifically the "who, how, what, and why" of the profession. The Focus Group participants reviewed a comprehensive list of duties and competencies to identify key Clean Energy Analyst job components.

The next step was to identify specialized skill areas. Once the Focus Group participants reached consensus on the duty areas, they delineated each duty by identifying the required knowledge and skills.

Meeting #2: The facilitator projected a spreadsheet that contained the identified duty areas and corresponding task statements. The industry practitioners and subject matter experts were asked to rank the competencies under each task and to identify the knowledge and skills, needed to complete each task. The Focus Group participants transitioned to the discussion about the Clean Energy Designer position and repeated the job analysis according.

Meeting #3: Work concluded with the industry practitioners and subject matter experts finalizing an overarching job analysis for Clean Energy Designer.

FOCUS GROUP CHALLENGES

- Finding qualified candidates to hire
- Only a few training programs available
- Potential job seekers are not aware or do not view building operations as a career path
- Community colleges viewed as a potential partner, but firms may not be actively working with them to find candidates
- Candidates often hired with some skills and learn the rest on the job (OJT)
- Ongoing need to assess and develop skills for current and new hires
- Few employers have a plan for training those already in their workforce
- Technicians generally are neither motivated nor incentivized to pursue training on their own outside of the job

FOCUS GROUP RECOMMENDATIONS

- Focus on opportunities for training of new workforce and for the re-training of those already in the field

REQUESTED FOCUS GROUP PARTICIPANTS

NAME	TITLE	ORGANIZATION
Dan Luzius*	Mechanical Designer	DLR Group
Sean Avery*	Mechanical Designer	DLR Group
Tamas Bencsik	Senior Engineer	Coffman Engineers, Inc
~~Carmen Cejudo~~	~~Mechanical Engineer~~	~~PAE~~
Don Mitchell*	Strategic Solutions Director	Trane
Krishnan Gowri*	Principal Engineer	AutoDesk
Michael Baranick	Principal Engineer	Hargis Engineers
Hwakong Cheng	Mechanical Engineer	Taylor Engineering, LLC
Chris Spurlock*	Energy Engineer	ATS Automation
John Heller*	Mechanical Engineer	Ecotope
Linda Burman*	Principal Engineer	Burman Design
Laura Jean Humiston*	Energy Services Analyst	Hargis Engineers

*Indicates participated in the Focus Group meetings

JOB TASK ANALYSIS – CLEAN ENERGY ANALYST

The proposed definition and outline for Clean Energy Designer resulted from this Job/Task Analysis.

> A ***CLEAN ENERGY ANALYST*** is an energy solutions professional who collects and analyzes data related to site conditions, modeling, simulations, building systems and equipment, energy usage, and recommends strategies to reduce energy, water and associated costs to help meet established goals.

A. Conduct Needs Analysis Interviews

B. Analyze Building Operational Performance

C. Create High Performance Building Plans

WORKPLACE COMPETENCIES
CONDUCT NEEDS ANALYSIS INTERVIEWS
Request Project Documents for Analysis
• Request drawings and schedules
• Request utility data
• Calculate the EUI
• Utility Billing Analysis
• Benchmark building performance
• Aggregate data for analyses and reports
• Identify environmental requirements
• Trend utility usage and cost
ANALYZE BUILDING OPERATIONAL PERFORMANCE
Develop Conceptual Solutions
• List the identified measures of low cost/no cost, capital
• Select measures for further analysis
• Estimate preliminary savings, costs and pay-back for measures
Develop Analysis Approach
• Review data for quality and completeness
• Analyze needs for ENERGY STAR reporting and building certifications
• Determine the level of analysis required
• Determine the analysis method (spreadsheet, modeling software, outsourcing)
• Determine the level of interactions between potential measures
• Determine the sequence of the measures
• Determine impact of implementation scenarios
Develop Selected Measures
• Gather vendors equipment performance specifications
• Calculate greenhouse gas emissions
• Obtain payback analysis
• Allocate utility breakdown by end use
• Perform a trend data analysis
• Run computer simulations
• Calculate energy/water savings
• Review compliance requirements (codes, standards, guidelines, etc.)
• Develop an implementation description for the measures
• Perform waste analysis
• Evaluate the impact on operations and maintenance (financial and tasking)
CREATE HIGH PERFORMANCE BUILDING PLANS
Create High Performance Building Plans
• Identify utility rebates
• Review capital improvement plan
• Identify alternative energy opportunities
• Develop water conservation plan
• Prioritize audit recommendations

• Develop zero waste plan
• Develop energy plan
• Review predictive maintenance plan
• Develop control systems plan
• Develop systems integration plan
• Optimize equipment sequence of operations
• Develop operational performance metrics

CRITICAL WORK FUNCTIONS AND ASSOCIATED SKILLS
A: ASSESS REQUIREMENTS AND DESIGN OPPORTUNITIES
• Foundational building systems knowledge
• Construction and design
• Experience with on-site assessment of facilities
• Data gathering and documenting skills
• Knowledge of how to use energy and industry codes
• Interpersonal/interviewing skills
• Planning and organizational skills
• Understanding sustainability principles
• Research skills
B: IDENTIFY BUILDING SYSTEMS, FUNCTIONS
• Foundational building systems knowledge
• Understanding how different commercial HVAC systems work
• Knowledge of different building automation systems
• Ability to use basic diagnostic tools
• Understanding interactions between different building systems
• Basic understanding of electricity and how electrical systems work
• Ability to read plans/schematics
• Understanding of facility operations and maintenance services
• Basic understanding of fluid dynamics
• Ability to ascertain and document assumptions/estimations
• Psychometrics
• Knowledge of different lighting techniques (daylighting/task lighting)
• Knowledge of different lighting technologies (fluorescents/LEDs)
• Ability to assess occupant safety and health impacts of building systems
• Knowledge of personal safety and protection
C: ENERGY INFORMATION MODELING AND ANALYSIS
• Understand typical energy efficiency measures and how and when to apply them
• Understanding energy units of measurement
• Ability to create and manipulate spreadsheets
• Understanding the science of energy modeling (thermodynamics)
• Understanding modeling tools and limitations

• Ability to benchmark calculation results to “rule of thumb” (reality check)
• Understanding energy economics and rate structures
• Basic understanding of statistics and their application
• Advanced computer analysis (building simulation modeling software)
• Knowledge of standard energy benchmarking tools
• Understanding of energy generation and distribution systems
• Knowledge of metering technologies and understanding load profiles
• Ability to use climate data to normalize energy data
D: ECONOMIC AND BUSINESS CASE DEVELOPMENT
• Understanding of project economic analysis
• Ability to evaluate financial tools/resources for projects
• Writing and presentation skills
• Knowledge of construction cost estimation
• Ability to define and evaluate contractors and proposals
• Understanding basic maintenance functions and cost
• Ability to quantify/qualify environmental benefits
• Ability to identify and describe non-energy benefits to business operations
• Understanding basic business economics and management
E: PRESENT DATA AND OPPORTUNITIES FOR ENERGY EFFICIENCY
• Ability to prioritize and summarize
• Ability to communicate energy solutions to multiple audiences
• Writing and presentation skills
• Ability to translate technical information to non-technical audiences
• Ability to align energy solutions to business type and priorities
• Ability to show benefits of energy solutions to a business
• Ability to communicate and interact with company executives and other stakeholders
• Basic knowledge of contracts and agreements
• Ability to write M&V reports
F: COMMUNICATIONS WITH CUSTOMERS AND OTHER STAKEHOLDERS
• Ability to communicate professionally
• Strong writing and oral communication skills
• Ability to set expectations and deliverables
• Ability to plan, schedule, execute projects and meet deliverables
• Ability to collaborate with other technical experts
• Ability to adapt to changing circumstances
• Ability to conduct an effective inquiry process
• Ability to facilitate a design/planning process
• Ability to effectively participate in a group environment
• Ability to make group presentations to various stakeholders
• Ability to develop a response plan based on M&V results

G: PROFESSIONAL STANDARDS, ETHICS, AND LEADERSHIP
• Ability to understand and interpret technical codes, regulations and protocols

• Ability to self-direct personal professional development
• Ability to understand and apply emerging trends in the industry
• Understanding of relevant professional certifications and credentials
H: MEASUREMENT, VERIFICATION, AND RESPONSE
• Ability to define relevant M&V to EEM
• Ability to use measurement tools for performance verification
• Understand and interpret verification reports
• Ability to define systematic M&V protocols for implementation
• Understanding trend logging and building automation systems

CLEAN ENERGY DESIGNER - JOB TASK ANALYSIS

The proposed definition and outline for Clean Energy Designer resulted from this Job/Task Analysis.

A ***CLEAN ENERGY DESIGNER*** develops design specifications and requirements for high-performance buildings; to include site-specific analysis, modeling, simulations, analysis of building systems and equipment, implements strategies to reduce energy, water and associated costs to help meet established goals.

A. Defining Project Objectives
B. Gathering Data
C. Specifying Baseline Building
D. Developing Project Alternatives with Design Team
E. Constructing Models
F. Evaluating Model Results

WORKPLACE COMPETENCIES
A. DEFINING PROJECT OBJECTIVE
Review Project Requirements
• Review owner's project requirements
• Review basis of designs
• Communicate comments to design team
• Review code requirements
• Identify key energy indicators
Develop Recommendations
• Evaluate results from economic analysis
• Evaluate results from energy analysis
• Compare results to project goals
• Prepare recommendations
Create Report
• Summarize results of individual measures
• Summarize results of project alternatives
• Document model assumptions
• Highlight critical elements
• Detail recommendations
Perform Quality Control
Research Codes, Standards, and Protocols
• Determine compliance issues
• Identify energy modeling baselines
• Identify codes, standards, and protocols
Set Target Goals
• Communicate results to stakeholders
• Identify metrics of goals
• Research benchmarks
• Identify energy efficient and renewable approaches
• Assess building performance for each approach
Package Measures into Project Alternatives
Collect Incremental Costs
Compare Project Alternatives
Set Baselines
• Review baselines required for codes, standards, and protocols
• Identify additional baselines
B. GATHERING DATA
Compile Resources
• Review design documentation
• Reference energy knowledge base
• Identify utility rates

• Obtain weather files
• Research literature and reference materials
Resolve Data Gaps
• Identify data gaps
• Request missing data
• Document assumptions for missing data
• Document resources
C. SPECIFYING BUILDING BASELINE
• Recognize Baseline Methodology
• Specify Baseline Building Envelope System
• Specify Baseline Lighting System
• Specify Baseline HVAC System
• Specify Baseline Domestic Water System
• Specify Baseline Process Loads
D. DEVELOPING PROJECT ALTERNATIVES WITH DESIGN TEAM
Identify Supplemental Modeling Requirements
• Perform climate analysis
• Analyze energy end-use breakdowns
• Develop passive load reduction strategies
• Develop internal load reduction strategies
• Investigate HVAC system alternatives
• Investigate daylighting opportunities
• Develop active load reduction strategies
• Develop process load reduction strategies
• Investigate renewable opportunities
• Investigate HVAC controls strategies
• Investigate lighting control strategies
• Investigate existing system operations
• Correct operational deficiencies
• Generate facility improvement recommendations
• Discuss recommendations with owner and design team
• Investigate IEQ improvements
E. DEVELOP CONSTRUCTING MODELS
• Specify Utility Rates
• Divide Building into Thermal Blocks
• Specify Simulation Parameters
• Specify Site Conditions
• Construct Model Geometry
• Build Opaque Constructions
• Build Fenestration Constructions
• Specify Internal Lighting Loads
• Specify Occupancy Loads
• Specify Process Loads

• Specify Infiltration Loads
• Specify Schedules
• Specify Ventilation
• Develop HVAC Systems
• Specify Service Hot Water Loads/Systems
• Specify On-site Generation Systems
• Specify Performance Curves
• Specify Exterior Loads (loads that do not affect building heat balance)
• Integrate Supplemental Customized Calculations
• Create Models that Reflect Project Alternatives and Baselines
• Specify Control Sequences
F. EVALUATING MODEL RESULTS
Run Simulations
Calibrate Model Against Measured Data
• Compare results to project objectives
• Perform emissions inventory
• Identify non-energy benefits (IEQ)

Add statement for shared skills and knowledge across the Analyst and Designer skills.

SPECIALIZED KNOWLEDGE	
Air leakage testing	Incentive programs
Airflow analysis	Indoor air quality
Benchmark data	Industry rules of thumb for job costing
Billable rate structure	Innovative technologies
Biomass	Light pollution
Block charges	Lighting controls
BAS	Lighting design
Building control systems	M&V protocols
Building design and construction process	Mechanical noise
Building electrical systems	Metering and data logging
Building occupancy patterns	Modeling tools and capabilities
Building operations	Motors
Building physics	Numerical methods
Calculation algorithms	Occupant behavior
Codes, standards, and protocols	Open garage ventilation fans
Co-generation	PV
Color rendering index	Plug loads
Color temperature	Plumbing design
Commercial refrigeration	Power factor
Common industry publications	Psychrometrics

Compliance requirements	Ratchet charges
Consumption charge	Rebates and incentives
Control systems	Regression analysis
Cost estimating	Sensor technologies and reliability
Current sustainable technologies	Service water heating
Custom weather files	Software
Daylighting design	Solar radiation
Decision-making criteria	Solar thermal
Demand charge	Source to site conversion
Demands on project resources	Space conditioning types
Design metrics	Specialized building systems
District energy	Storage systems (e.g., thermal, energy)
Electrical design	Structure of utility tariffs
Emission coefficients	Survey instruments
Energy analysis methods	Sustainable design principles
Energy disaggregation	Technical language
Engineering economics	Thermal comfort
Environmental science	Thermal resistance networks
Equipment operating modes	Thermal science (e.g., heat transfer, fluid dynamics)
Fenestration technologies	Time clock controls
Financial analysis	Time of use
Fuel escalation charges	Utility rate structures
Geometry	Ventilation
Ground heat transfer	Visual comfort
HVAC controls	Weather data types
HVAC design	Weighted averages
Illumination levels	Wind power

GENERAL KNOWLEDGE
Basic Measurements
• Calculate the perimeter and areas of common figures
• Convert measurements from one unit to another (English to metric, etc.)
• Estimate and approximate measurements
• Find distances and directions on land maps
• Find the dimensions of an object from a scale drawing
• Make simple scale drawings
• Measure area (square inches, square centimeters, etc.)
• Measure length to 1/4 of an inch
• Measure linear distances (length, width, etc.)
• Measure temperature to within 1 degree F
• Measure volume (cubic inches, liters, etc.)

• Read and apply coefficient measurements indicated in a table or chart
• Read and use the scale of a drawing
• Read measurements taken with common measuring tools
• Read, interpret, and use size-scale relationships
• Record measurements, using appropriate unit notations (feet, yards, etc.)
• Use tools to measure quantities and solve problems involving measurements
Communications
• Apply assertiveness
• Ask questions
• Communicate using the vocabulary/terminology of a related trade
• Communicate with co-workers and/or business people in writing (letters, memos)
• Communicate with co-workers and/or business people verbally (face-to-face)
• Communicate with co-workers and/or business people verbally (telephone, radio)
• Evaluate options/alternatives
• Evaluate solutions
• Explain procedures
• Find information in catalogs
• Find information in references (machinery handbook, tap/drill charts, etc.)
• Follow verbal job instructions
• Listen
• Participate in brainstorming
• Present to others
• Read and follow a map, chart, plan, etc.
• Read and follow directions found in equipment manuals and code books
• Read and interpret directions found on labels, packages, or instruction sheets
• Read codes (building codes, electrical codes, standards, etc.)
• Read drawings and specifications sheets
• Read flowcharts
• Read information from tables and graphs (bar, circle, etc.)
• Read statistical data
• Research information
• Summarize information
• Write reports
• Write words and numbers legibly
Calculations
• Change numbers from fraction into decimals and back
• Change numbers from percent into decimals and back
• Collect information to solve a problem
• Compare numbers
• Figure averages
• Make rough estimates
• Measure angles
• Multiply and factor algebraic expressions

• Perform angular calculations
• Perform math operations using exponential numbers
• Perform math operations using signed (positive and negative) numbers
• Perform math operations using single and
• multiple digit numbers
• Perform mathematical operations with decimals
• Perform mathematical operations with fractions
• Perform math operations using signed (positive and negative) numbers
• Perform simple math operations of addition
• Perform simple math operations of division
• Perform simple math operations of multiplication
• Perform simple math operations of subtraction
• Solve formula calculations with more than one unknown
• Solve formula calculations with one unknown
• Solve oblique triangle problems
• Solve percent problems
• Solve problems with graphs
• Solve ratio problems
• Solve right triangle problems using Pythagorean theorem
• Solve right triangle trigonometry problems
• Transfer number sequences from a source into a column
• Use a calculator
• Solve right triangle problems using Pythagorean theorem

PROPOSED CURRICULUM AND COURSE OUTLINES

Large Building Assessment: Energy Technologies Measurements

Proposed Title: Large Building Assessment: Energy Technologies Measurements (NRG 162)
Credits: 4 credits: (44 contact hours)
Course Format: In-Person Lecture / Online Content – Hybrid
Grading Option: Decimal grade

COURSE DESCRIPTION:

This class covers large building - or "other than residential", assemblies, systems, and energy efficiency technologies. The class is designed to help you understand how buildings work as an integrated system and become familiar with all the building components, systems, technologies and operation. This course will cover the basics of building science including heat, air and moisture flow, and psychrometry. You will also learn about designing high performance building envelope, HVAC, lighting and controls systems. Finally, you will be introduced to the basics of building auditing for identifying energy efficiency measures and operational improvements.
We will use a variety of on-line resources and software tools in our work, in addition to a text book and supplementary reading materials.

COURSE TOPICS:

- Building Science Basics
- Psychrometry and climate data
- Lighting systems
- Building Retuning (low cost/no cost measures)
- Heat, air and moisture flow
- Building envelope systems
- HVAC Systems – Single zone and multi-zone systems
- Energy benchmarking

COURSE OBJECTIVES:

- Given a building, energy system or renewable energy technology, the learner will be able to gather information and/or data, describe, analyze, and document
- Common large building envelope assemblies and principles related to energy use
- Common lighting technologies and principles related to energy use
- Common large building mechanical systems technologies and principles related to energy use
- Common building automation systems (energy management systems) and operational strategies related to energy use

Large Building Energy: Methods & Measurements

Proposed Title: Large Building Energy: Methods & Measurements (NRG 163, Prerequisite NRG 162)
Credits: 4 credits: (44 contact hours)
Course Format: In-Person Lecture / Online Content – Hybrid
Grading Option: Decimal grade

Course Description:
The objective of this 4 Credit course is to prepare students for identifying energy efficiency opportunities and making recommendations on improving energy performance of medium and large commercial buildings. The course will introduce the methods and measurements used for commercial building energy audits and assessments. Prerequisite: Completion of NRG 162 or Instructor Permission.

Course Topics:

- Review EUI, ECI and Energy End Use
- Energy Audit
- Walkthrough Audit
- Analyze Data
- Building Operational Assessments
- Report Writing and Presentations
- Energy Benchmarking
- ASHRAE Audit Levels
- Collect Data
- HVAC System Assessments
- Payback Period Analysis
    -

Course Objectives:

- Understand the basics of energy bench marking and energy end use
- Be able to collect utility billing data and analyze the energy use trends with weather data
- Understand the basics of energy auditing process and the standard ASHRAE energy audit levels
- Use field measurement tools such as flow meters, light meters, data loggers to collect field data for energy auditing
- Identify energy efficiency opportunities using walkthrough audit of building exterior, interior and mechanical rooms
- Understand the process of lighting audit by collecting lighting fixtures data, operational schedules and lighting controls and validating this
- Collect name plate data from mechanical equipment for analysis
- Understand the operation of economizers, terminal units, air handlers and central heating and cooling systems
- Understand the principals of building automation systems, ability to collect trend data and analyze them to identify operational faults/opportunities

Virtual Design for Energy Technologies

Proposed Title: Virtual Design for Energy Technologies (NRG 181, Prerequisite NRG 163)
Credits: 5 credits: (55 contact hours)
Course Format: In-Person Lecture-Lab / Online Content – Hybrid
Grading Option: Decimal grade

Course Description:

The objective of this 5 Credit course is to prepare students with foundational technical skills in the use of Building Information Modeling (BIM) for high performing/renewable energy systems in the built environment. Topics include whole building energy systems modeling for design, analysis, and detailing. The course focuses on Autodesk Revit MEP.

Course Rationale:

Building information modeling (BIM) has become the industry standard practice for documenting and communicating design information quickly and effectively. Autodesk Revit is widely used by architects, designers and modelers as a primary BIM authoring tool. BIM data is used by analysis tools for energy, solar and lighting performance. The quality of BIM models for analysis is highly dependent on the content and completeness of design information in the model. This course will provide the necessary technical background and hands-on training to create BIM models that can be used for energy analysis and related building performance.

Course Topics:

- Introduction to BIM
- Define Spaces and Zones
- Heating and Cooling Loads Analysis
- HVAC Networks
- Create BIM Models
- Model Views and Model Validation
- Interoperability and Energy Simulation
- Solar and Lighting Analysis

Course Objectives:

- Understand the basics of Building information Modeling
- Be able to create and enhance BIM models of MEP systems in Revit models
- Understand the basics of collecting and representing energy analysis requirements in BIM models including: Thermal properties of envelope materials and components, Thermal zone properties, Space properties
- View and validate BIM models for heating and cooling loads analysis
- Learn to export gbXML data for load and energy calculation using third party analysis software
- Learn to perform solar and lighting analysis for determining PV potential and LEED compliance
- Prepare reports, charts and rendered BIM models for client presentations

PROPOSED JOB DESCRIPTION

Clean Energy Technologist

Key Responsibilities

- Select tools and approaches to analyze building design features to provide strategic guidance to project owners, developers, and architectural partners at each design phase.
- Evaluate complex energy efficiency solutions for large commercial, new construction, and retrofit projects.
- Work with Project and Design Engineers to ensure systems are modeled accurately and documentation is precise and complete.
- Develop model input and output documentation and methodology descriptions that are clear and easy to review.
- Obtain and analyze client data using Excel models
- Perform energy modeling analyses
- Review and analyze construction drawings
- Write detailed reports and narratives
- Research, understand, and analyze codes and regulations
- Interview clients in-person, over the phone, and via e-mail

Project Management

- Manage assigned projects.
- Solicit input and guidance from others when needed.
- Document assumptions, model inputs, client direction, and internal decision-making.
- Develop and adhere to methods for improving energy modeling consistency and work flow.

Communication

- Communicate with external team members to set expectations and drive successful energy modeling interactions from start to finish.
- Work closely with internal team members to drive clarity regarding project schedules, required content and level of detail, and type of outputs needed.
- Foster collaboration, internally and externally, through all phases of the energy modeling process.

Qualifications

- Clean Energy Designer or Analyst certificate or AA degree.
- Familiarity with industry standard calculation methods including, but not limited to, degree day method, bin method, hourly simulation, lighting calculations, affinity laws, and electrical load and power calculations, required
- Exposure to natural ventilation modeling, thermal comfort modeling, and daylight analysis preferred.
- Proficiency with CAD, Drafting, and/or BIM a plus
- Highly Proficient in Microsoft Office (Outlook, Excel, PowerPoint, etc.)
- Time management and attention to detail
- Ability to prioritize and multi-task on a variety of tasks and projects
- Clear written and verbal communication skills, strong documentation skills
- Strong client interaction skills

Additional Skills and Qualifications

- Two (2) years energy modeling experience required.
- Two (2) years of mechanical or electrical design experience preferred.
- Exposure to other software including BIM, AUTOCAD
- Exposure to submitting LEED project documentation

SAMPLE SURVEY QUESTIONS

1. **Please select the job title that most closely defines your role in the facility operations and/or management industry.**
   - ☐ **Chief Engineer**
   - ☐ **Lead Technician**
   - ☐ **Building Technician**
   - ☐ **Property Manager**
   - ☐ **Facility Manager**

2. **Are you involved in the supervising, hiring, and/or training of building technicians or employees in HVAC, mechanical, electrical or plumbing industries?**
   - ☐ **Yes**
   - ☐ **No**

3. **Please indicate which of the following tasks you are in charge of on a daily basis? (Select all that apply)**
   - ☐ **Measure and track energy usage**
   - ☐ **Optimize and manage energy**
   - ☐ **Select and specify building systems for design**
   - ☐ **Conduct building energy analysis**
   - ☐ **Perform energy code compliance**
   - ☐ **Develop building information models**
   - ☐ **Collect data and monitor building systems**
   - ☐ **Respond to tenant and occupant requests**
   - ☐ **Conduct equipment checks**
   - ☐ **Conduct daily inspections**
   - ☐ **Monitor indoor environmental quality**
   - ☐ **Maintain the facility and systems**

4. **Please indicate the highest level of education you have received**
   - ☐ **Bachelor's degree or higher**
   - ☐ **Associates degree or other community college degree**
   - ☐ **Union training (EX: journeyman, etc.)**
   - ☐ **High school diploma or equivalent**

5. **Please indicate how many years of experience you have in the facility operations and/or management industry?**
    - ☐ **0-2**
    - ☐ **3-5**
    - ☐ **6-10**
    - ☐ **11-20**
    - ☐ **20+**

6. **Do you feel that there is a need for training ~~and certification~~ for high performance building systems technicians?**
    - ☐ **Yes**
    - ☐ **No**

7. **Would you give preference to hiring someone with training from such a program?**
    - ☐ **Yes**
    - ☐ **No**

8. **What industry software applications or skills are needed for you to perform your job? (Select all that apply)**
    - ☐ **BIM Tools (Revit M/E/P)**
    - ☐ **Energy Simulation Tools (E-Quest, IES, Energy Plus, Trane/Trace)**
    - ☐ **Benchmarking Tools (Portfolio Manager, AIA 2030 Challenge, Zero Tool)**
    - ☐ **Other: Please list**

9. **Please rank the priorities of the following task from highest to lowest:**
    - ☐ **HVAC Equipment System Commissioning**
    - ☐ **Building Automation System Commissioning**
    - ☐ **Lighting System Commissioning**
    - ☐ **Envelope System Commissioning**

10. **Please provide additional comments.**

Enter additional comments here

REFERENCES

National Renewable Energy Laboratory-Job Task Analysis: Energy Auditor https://www.energy.gov/sites/prod/files/2014/01/f7/51672.pdf

National Institute of Building Sciences-Job Task Analysis Building Energy Auditor https://c.ymcdn.com/sites/www.nibs.org/resource/resmgr/CWCC/AT03a_BldgEnergyAuditor_JTA.pdf

U. S. Department of Energy-Job Task Analysis Commercial Building Energy Modeler https://www1.eere.energy.gov/buildings/commercial_initiative/pdfs/energy_modeler_jta_comment.pdf

U. S. Department of Energy-Job Task Analysis Commercial Building Energy Auditor https://www1.eere.energy.gov/buildings/commercial_initiative/pdfs/energy_auditor_jta_comment.pdf

Building Efficiency for a Sustainable Tomorrow- High-Performance-Building-Operations-Professional-Chart https://www.bestctr.org/wp-content/uploads/2016/07/High-Performance-Building-Operations-Professional-Chart-08-1.pdf