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BUILDING TECHNOLOGIES

Job/Task Analysis for a Commercial Building Energy Modeler: Public Comment Draft

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Commercial Building Energy Modeler
Job Description

A Commercial Building Energy Modeler constructs engineering and economic models to represent the performance of buildings, in order to evaluate and quantify the impact of policy, design, retrofit and operational decisions.

A proposed content outline resulting from this Job/Task Analysis follows.

Commercial Building Energy Modeler	
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
G	Communicating Analysis Results
H	Implementing Project

This Job/Task Analysis used input from a broad group of industry practitioners and was facilitated by Professional Testing, Inc. for the National Renewable Energy Laboratory and the U.S. Department of Energy.

Contents

1.0 Introduction

The National Renewable Energy Laboratory secured the services of Professional Testing to help develop a job/task analysis (JTA) for commercial building energy modelers.

JTA is a procedure for analyzing the tasks performed by individuals in an occupation, as well as the knowledge, skills, and abilities required to perform those tasks. Specifically, a JTA can be defined as "any systematic procedure for collecting and analyzing job-related information to meet a particular purpose" (Raymond 2001). JTA can be used to describe, classify, and evaluate jobs; ensure compliance with legal and quasi-legal requirements; develop training, promote worker mobility, plan workforces, increase efficiency and safety, and appraise performance (Brannick et al. 2007).

JTA is traditionally used by secondary and postsecondary educators, test developers, and business, industry, government, and military trainers to help identify core knowledge areas, critical work functions, and skills that are common across a representative sampling of current practitioners.

This project used the "developing a curriculum" (DACUM) method to conduct a JTA. DACUM is an occupational analysis led by a trained facilitator, where practitioners in a specific occupation come together for a multiday workshop to provide input about the specific tasks, knowledge, and skills needed to perform their job.

This document provides draft results of the analysis and will form the basis for a subsequent "industry validation" phase, where a larger group of industry practitioners will evaluate the list of job-related tasks. This group will ensure that the identified tasks and weighting factors accurately represent the job of a commercial building energy modeler. This step will also provide an opportunity for industry to identify any missed tasks or any that were included erroneously.

The content presented in this document was created by industry practitioners and is intended to portray the job of a commercial building energy modeler as currently practiced.

2.0 Subject Matter Expert Selection Process

Professional Testing helped to establish the criteria for selecting the DACUM panel of subject matter experts (SMEs). To be eligible for the workshop panel, applicants were required to submit an electronic application and to demonstrate that they were active practitioners in their field. To create a representative panel of practitioners, Professional Testing selected SMEs from a larger applicant pool to ensure:

- Geographic diversity
- Representation of a wide range of experience levels (novice to expert)
- No single organization or organization size dominated the group
- All sectors were represented with no single sector dominating (public versus private)
- Diversity of industry-related credentials, represented by the panelists.

Eleven applicants meeting the above criteria were selected to create the commercial building energy modeler SME panel.

3.0 Job/Task Analysis Workshop

The commercial building energy modeler JTA workshop was held in Greenwood Village, Colorado, June 7-9, 2011.

The DACUM Philosophy:

- **Practitioners can describe and define their jobs more accurately than anyone else.**
- **One of the most effective ways to define a job is to describe the tasks practitioners perform.**
- **All jobs can be effectively and sufficiently described in terms of the tasks successful workers perform.**
- **All tasks, to be performed correctly, demand certain knowledge, skills, abilities, attributes, and tools.**

Day 1 consisted of an introduction to the DACUM process. The trained DACUM facilitator explained the JTA process and provided the SME panel with duty and task statement definitions. A duty reflects a large area of work for a specific profession; multiple tasks describe how to perform each duty. The presentation then shifted to a discussion about commercial building energy modelers, more specifically the "who, how, what, and why" of the profession. The SME panelists compiled this information into a comprehensive list to capture key commercial building energy modeler job components.

The next step was to identify duty (or domain) areas. Once the SME panelists reached consensus on the duty areas, they delineated each duty by identifying the required tasks.

On Day 2, the facilitator projected a spreadsheet that contained the identified duty areas and corresponding task statements. The SMEs were asked to list the steps under each task and to identify the knowledge, skills, abilities, and tools needed to complete each task.

On Day 3, work concluded with the SMEs finalizing an overarching job description for commercial building energy modelers.

4.0 Results

This document presents aspects of a commercial building energy modeler, as captured by the 11-member panel during the June 7-9, 2011 JTA workshop in Greenwood Village, Colorado. The tables that follow reflect job requirements and are meant to provide a clear understanding and detailed description of the work performed.

5.0 References

Brannick, M. T., Levine, E. L., & Morgeson, F. P. (2007). Job and work analysis: Methods, research and *applications for human resource management*. Thousand Oaks, CA: Sage.

Raymond, M.R. (2001). Job analysis and the specification of content for licensure and certification examinations. *Applied Measurement in Education 14*(4), 369-415.

6.0 Nomenclature

Table 1 provides a list of the acronyms and abbreviations used in this document. In addition to increasing the efficiency of communications, many technical and process acronyms are useful in memory retention and learning. Occupational acronyms are therefore of interest to trainers and curriculum designers.

Table 1: List of Acronyms and Abbreviations

Nomenclature	Definition
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BAS	Building automation system
BIM	Building information modeling
CAD	Computer-aided design
CBECS	Commercial Building Energy Consumption Survey
CEUS	California Commercial End-Use Survey
CFD	Computational fluid dynamics
CIBSE	Chartered Institution of Building Services Engineers
CO_2	Carbon dioxide
COMNET	Commercial Energy Services Network
DACUM	Developing a curriculum
dB	Decibel
EPA	Environmental Protection Agency
F	Fahrenheit
FCU	Fan coil unit
HVAC	Heating, ventilation, and air-conditioning
IEQ	Indoor environmental quality
IES	Illuminating Engineering Society
IESNA	Illuminating Engineering Society of North America
IRS	Internal Revenue Service
JTA	Job/task analysis
LEED	Leadership in Energy & Environmental Design
M&V	Measurement and verification
PV	Photovoltaic
SME	Subject matter expert
USGBC	United States Green Building Council
VAV	Variable air volume

7.0 Proposed Content Blueprint

The SMEs rated the list of job-related duties defined during the JTA workshop based on a two-factor scale: the importance of the duty area to overall job performance and the frequency with which duties are performed. The result is a weighted ranking of the duties known as a *content blueprint*.

The proposed content blueprint provides an initial basis from which an assessment (e.g., a certification or licensure examination) may be constructed and provides curriculum developers with a model to align training to the core needs of the occupation.

Table 2: Proposed Content Blueprint for Commercial Building Energy Modelers

	Duties and Tasks	Weighting
A	**Defining Project Objectives**	**7%**
1	Conduct Integrative Design Charrette	
2	Review Project Requirements	
3	Develop Internal Project Plan	
4	Research Codes, Standards, and Protocols	
5	Set Target Goals	
6	Set Baselines	
7	Select Analysis Method	
B	**Gathering Data**	**10%**
1	Define Modeling Data Requirements	
2	Compile Resources	
3	Resolve Data Gaps	
4	Collect On-site Data (existing building)	
5	Assess Existing Conditions (existing building)	
C	**Specifying Baseline Building**	**13%**
1	Recognize Baseline Methodology	
2	Specify Baseline Building Envelope System	
3	Specify Baseline Lighting System	
4	Specify Baseline HVAC System	
5	Specify Baseline Domestic Water System	
6	Specify Baseline Process Loads	
D	**Developing Project Alternatives with Design Team**	**15%**
1	Brainstorm Facility Improvement Measures	
2	Package Measures into Project Alternatives	
3	Identify Supplemental Modeling Requirements	
4	Collect Incremental Costs	

Table 2 (Continued): Proposed Content Blueprint for Commercial Building Energy Modelers

	Duties and Tasks	Weighting
E	**Constructing Models**	**23%**
1	Divide Building into Thermal Blocks	
2	Specify Simulation Parameters	
3	Specify Site Conditions	
4	Construct Model Geometry	
5	Build Opaque Constructions	
6	Build Fenestration Constructions	
7	Specify Internal Lighting Loads	
8	Specify Occupancy Loads	
9	Specify Process Loads	
10	Specify Infiltration Loads	
11	Specify Schedules	
12	Specify Ventilation	
13	Develop HVAC Systems	
14	Specify Service Hot Water Loads/Systems	
15	Specify On-site Generation Systems	
16	Specify Performance Curves	
17	Specify Control Sequences	
18	Specify Exterior Loads (loads that do not affect building heat balance)	
19	Integrate Supplemental Customized Calculations	
20	Specify Utility Rates	
21	Create Models that Reflect Project Alternatives and Baselines	
F	**Evaluating Model Results**	**18%**
1	Run Simulations	
2	Perform Quality Control	
3	Calibrate Model Against Measured Data	
4	Compare Project Alternatives	
5	Perform Economic Analysis	
6	Develop Recommendations	
G	**Communicating Analysis Results**	**6%**
1	Create Report	
2	Guide Decision Making of Stakeholders	
3	Complete Compliance Documentation	
4	Maintain Energy Knowledge Base	
H	**Implementing Project**	**8%**
1	Review Construction Documents	
2	Analyze Utility Bills	
3	Conduct M&V	
4	Share Lessons Learned	
Total		**100%**

8.0 Knowledge

The SMEs identified and categorized specific types of knowledge needed to be a proficient commercial building energy modeler (Table 3). General knowledge areas (calculations, basic measurements, and communications), although not exclusive to this occupation, were also identified using a group consensus process (Table 4). The panelists concluded that a practitioner must master the knowledge in both tables to be competent as a commercial building energy modeler.

Table 3: Specialized Knowledge Required of Commercial Building Energy Modelers

Specialized Knowledge	
Air leakage testing	Energy analysis methods
Airflow analysis	Energy disaggregation
Architectural design	Engineering economics
Benchmark data	Environmental science
Billable rate structure	Equipment operating modes
Biomass	Fenestration technologies
Block charges	Financial analysis
BAS	Food service
Building control systems	Fuel escalation charges
Building design and construction process	Geometry
Building electrical systems	Ground heat transfer
Building occupancy patterns	HVAC controls
Building operations	HVAC design
Building physics	Illumination levels
Calculation algorithms	Incentive programs
Codes, standards, and protocols	Indoor air quality
Co-generation	Industry rules of thumb for job costing
Color rendering index	Innovative technologies
Color temperature	Leasing structures
Commercial refrigeration	Light pollution
Common industry publications	Lighting controls
Compliance requirements	Lighting design
Computational fluid dynamics	M&V protocols
Consumption charge	Mechanical noise
Control algorithms	Metering and data logging
Control systems	Modeling tools and capabilities
Convergence techniques	Motors
Cost estimating	Numerical methods
Current sustainable technologies	Occupant behavior
Custom weather files	Open garage ventilation fans
Daylighting design	Optics
Decision-making criteria	Organization mission and goals
Demand charge	Organization of database
Demands on project resources	Photometric controls
Design metrics	Photometry
Deviation reports	PV
District energy	Plug loads
Electrical design	Plumbing design
Emission coefficients	Power factor

Table 3 (Continued): Specialized Knowledge Required of Commercial Building Energy Modelers

Specialized Knowledge	
Psychrometrics	Structure of utility tariffs
Ratchet charges	Survey instruments
Rebates and incentives	Sustainable design principles
Regression analysis	Technical language
Safety	Thermal comfort
Sensor technologies and reliability	Thermal resistance networks
Service water heating	Thermal science (e.g., heat transfer, fluid dynamics)
Software	Time clock controls
Solar radiation	Time of use
Solar thermal	Utility rate structures
Source to site conversion	Ventilation
Space conditioning types	Vertical transportation
Specialized building systems	Visual comfort
Statistical analysis	Weather data types
Statistical methods	Weighted averages
Storage systems (e.g., thermal, energy)	Wind power

Table 4: General Knowledge Required of Commercial Building Energy Modelers

General Knowledge	
Calculations	
Change numbers from fraction into decimals and back	Perform simple math operations of addition
Change numbers from percent into decimals and back	Perform simple math operations of division
Collect information to solve a problem	Perform simple math operations of multiplication
Compare numbers	Perform simple math operations of subtraction
Figure averages	Solve formula calculations with more than one unknown
Make rough estimates	Solve formula calculations with one unknown
Measure angles	Solve oblique triangle problems
Multiply and factor algebraic expressions	Solve percent problems
Perform angular calculations	Solve problems with graphs
Perform math operations using exponential numbers	Solve ratio problems
Perform math operations using signed (positive and negative) numbers	Solve right triangle problems using Pythagorean theorem
Perform math operations using single and multiple digit numbers	Solve right triangle trigonometry problems
Perform mathematical operations with decimals	Transfer number sequences from a source into a column
Perform mathematical operations with fractions	Use a calculator

Table 4 (Continued): General Knowledge Required of Commercial Building Energy Modelers

General Knowledge	
Basic Measurements	
Calculate the perimeter and areas of common figures	Measure temperature to within 1 degree F
Convert measurements from one unit to another (English to metric, etc.)	Measure volume (cubic inches, liters, etc.)
Estimate and approximate measurements	Read and apply coefficient measurements indicated in a table or chart
Find distances and directions on land maps	Read and use the scale of a drawing
Find the dimensions of an object from a scale drawing	Read measurements taken with common measuring tools
Make simple scale drawings	Read, interpret, and use size-scale relationships
Measure area (square inches, square centimeters, etc.)	Record measurements, using appropriate unit notations (feet, yards, etc.)
Measure length to 1/4 of an inch	Use tools to measure quantities and solve problems involving measurements
Measure linear distances (length, width, etc.)	
Communications	
Apply assertiveness	Present to others
Ask questions	Read and follow a map, chart, plan, etc.
Communicate using the vocabulary/terminology of a related trade	Read and follow directions found in equipment manuals and code books
Communicate with co-workers and/or business people in writing (letters, memos)	Read and interpret directions found on labels, packages, or instruction sheets
Communicate with co-workers and/or business people verbally (face-to-face)	Read codes (building codes, electrical codes, standards, etc.)
Communicate with co-workers and/or business people verbally (telephone, radio)	Read drawings and specifications sheets
Evaluate options/alternatives	Read flowcharts
Evaluate solutions	Read information from tables and graphs (bar, circle, etc.)
Explain procedures	Read statistical data
Find information in catalogs	Research information
Find information in references (machinery handbook, tap/drill charts, etc.)	Summarize information
Follow verbal job instructions	Write reports
Listen	Write words and numbers legibly
Participate in brainstorming	

9.0 Skills, Abilities, and Attributes

A proficient worker possesses key skills, abilities, and attributes that influence job success. Skills are developed through experience and training and may apply to a wide range of tasks; proper skills enable workers to perform their tasks with precision and quality.

Abilities and attributes are more fundamental than knowledge and skills; they represent underlying, enduring traits, both cognitive and physical, that support the successful performance of a wide range of job tasks.

The panelists identified task-specific skills and abilities, as well as broad attributes (e.g., analytic, creative, patient), to define the recommended traits a commercial building energy modeler should possess (Table 5).

Human Resource professionals and job analysts often analyze skills, abilities, and attributes to compare jobs in terms of worker characteristics.

Table 5: Skills, Abilities, and Attributes Required of Commercial Building Energy Modelers

Skills, Abilities, and Attributes	
Ability to interpret blower door data	Dependable
Ability to interpret building design documents	Detail-oriented
Ability to interpret building diagrams/drawings	Drafting skills
Ability to interpret code, standard, and protocol language	Eager to learn new things
Ability to interpret control diagrams and sequences	Engineering skills
Ability to interpret design documentation	Ethical
Ability to interpret measured data	Facilitation skills
Ability to interpret metered data	Field engineering skills
Ability to interpret survey data	Focused
Ability to interpret utility tariffs	Goal-oriented
Ability to interpret weather file structure	Honest
Ability to manage large amounts of data	Initiative
Ability to recognize field conditions	Integrity
Accurate/precise	Listening skills
Adaptable/flexible	Logical thinking
Analytical skills	Manage stress/pressure
Budgeting skills	Math skills
Common sense	Meticulous
Communication skills	Multi-tasking skills
Comparative analysis skills	Observation skills
Computer skills	Organizational skills
Conscientious	Patience
Constructing abstract models	Persistent
Cooperative	Physics
Creative	Positive attitude
Critical thinking skills	Presentation skills
Customer-oriented	Pride in job
Data analytic skills	Professional
Data processing	Project management skills
Data reduction	Quality focused

Table 5 (Continued): Skills, Abilities, and Attributes Required of Commercial Building Energy Modelers

Skills, Abilities, and Attributes	
Research skills	Temporal awareness
Responsible/accountable	Time estimating
Safety conscious	Time management skills
Site survey skills	Trustworthy
Spatial skills	Unbiased
Team player	Whole systems thinking
Technical judgment	

10.0 Tools, Equipment, and Resources

Each occupation requires a unique set of support materials. It is important to identify the tools, equipment, and other tangible objects, as well as the resources (e.g., information technologies, codes and standards) required for a worker to effectively accomplish tasks. Table 6 lists the panelist-identified inventory of tools, equipment, and resources necessary to perform the identified tasks.

Table 6: Tools, Equipment, and Resources Used by Commercial Building Energy Modelers

Tools, Equipment, and Resources	
General Tools, Equipment, and Resources	
Airflow analysis tools/software	Gantt chart
Anemometer	Graphing software
Benchmark database	Greenhouse gas emission calculators
Building design documentation	Humidity sensors
Building energy consumption databases	Industry publications and journals
BIM	Industry reference materials
Building leakage test equipment	Infrared/laser thermometer
Building system control vendor	Knowledge database
Calendar	Life cycle cost software
Clamp meter	Light meter
CO_2 sensor	Lighting analysis tools
Code compliance software	Lighting rendering tools
Codes, standards, and protocols	Lighting standards and guidelines
Commercial building reference models	Material databases
Compliance packages	Modeling standards and guidelines
CFD software	Modeling tool documentation/user guide
CAD software	Modeling tools/software
Computer(s)	Moisture transport software
Construction project management software	Occupancy simulation tool
Cost estimating databases	Online forums
Current meter	Onsite generation modeling software
Data logger	Power meter
Data processing software	Pre-processing tools (whole building energy modeling)
Data visualization tools/software	Presentation software
Databases	Professional literature
Daylighting software	Project management software
dB meter	Psychrometric charts
Digital camera	Public economic data
Energy accounting software	Publication software
Energy analysis tools	Reference material/tables
Energy knowledge database	Regional utility rates
Energy modeling software	Satellite imaging tools
Energy simulation tools/software	Sensors
Engineering economic reference tables	Simulation software/tools
Engineering/architectural scale	Software user guides
Equipment selection tools	Spreadsheet software
Fenestration modeling software	Statistical analysis packages
File comparison software	Statistical and analytical tools

Table 6 (Continued): Tools, Equipment, and Resources Used by Commercial Building Energy Modelers

Tools, Equipment, and Resources	
General Tools, Equipment, and Resources	
Survey tools	Volt meter
Technical journals	Water utility data
Thermal imaging camera	Weather databases
Two-dimensional heat transfer software	Weather file conversion tools
Unit conversion software	Weather stations
Utility bill data/rate structure	Window modeling software
Vendor manufacturer data	Word processing software
Codes, Standards, and Guidelines	
Building Energy Standards, Protocols & Rating Systems	
ASHRAE 55.1	California Title 24 Standards and Manuals
ASHRAE 62.1	Carbon Neutrality & Building Energy
ASHRAE Building Energy Quotient Program	CIBSE Applications Manual 10
ASHRAE Handbooks	COMNET Modeling Guidelines Procedures
ASHRAE user manuals (90.1, 189.1, 62.1)	ENERGY STAR Portfolio Manager
ASHRAE/IESNA 90.1	IRS Tax Deduction Section 179D
ASHRAE/IESNA Standard 100	Net Zero Energy Buildings
ASHRAE/USGBC/IES Standard 189.1	USGBC LEED®
Building Energy Calibration	
ANSI/ASHRAE 140-2007 Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs	
ASHRAE Guideline 14	
Federal Emergency Management Program, Measurement & Verification Guidelines – Measurement & Verification of Federal Energy Projects, U.S. Department of Energy, Washington D.C.	
International Performance Measurement & Verification Protocol	
Building Energy Software Verification Standard	
ANSI/ASHRAE 140-2007 Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs	
Reference Databases	
CEUS	
CBECS	
Energy Star Equipment and Appliances	
EPA Target Finder	

11.0 DACUM Chart

The DACUM chart (Table 7) is a tabular representation of the JTA. Capital letters identify major job duty areas. Numbers identify tasks, and lowercase letters identify the steps required to accomplish each task. Moving horizontally across the chart, adjacent columns detail (1) specialized knowledge, (2) skills and abilities, and (3) tools, equipment, and resources required to perform each task. The information contained in these columns is related to each task and does not necessarily correspond to a specific step.

The importance of the DACUM chart is to show the relationship between job tasks and the specialized knowledge, skills and abilities, and tools, equipment, and resources required to perform each task. This concept, called *job-relatedness*, is essential to compliance with key legal and professional validity standards pertaining to the use of JTA information in employee selection. Such information is also critical to the development of high-stakes assessments for occupational licensing and certification examinations.

The DACUM chart depicts the job element relationships associated with each task, and can therefore easily be used to assess the relevance of current programs (curriculum), develop instructional objectives and training content, sequence instructional materials, and develop examination, competency, and performance evaluation instruments.

Table 7: DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
A	**Defining Project Objectives**			
1	Conduct Integrative Design Charrette			
a	Identify stakeholders	• Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • Energy analysis methods • HVAC design • Lighting design • Modeling tools and capabilities • Sustainable design principles • Thermal science (e.g., heat transfer, fluid dynamics)	• Common sense • Communication skills • Computer skills • Engineering skills • Facilitation skills • Math skills • Organizational skills • Patience • Presentation skills • Project management skills	• Benchmark database • Codes, standards, and protocols • Computer(s) • Energy modeling software • Presentation software • Word processing software
b	Schedule meeting with stakeholders			
c	Create meeting agenda			
d	Perform preliminary climate and site analysis			
e	Prepare project background materials			
f	Perform conceptual energy analyses			
g	Review benchmarks			
h	Review codes, standards, and protocols			
i	Conduct goal setting exercise			
2	Review Project Requirements			
a	Review owner's project requirements	• Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • HVAC design • Leasing structures • Lighting design • Sustainable design principles	• Common sense • Communication skills • Computer skills • Engineering skills • Math skills • Patience	• Computer(s) • Word processing software
b	Review basis of designs			
c	Review code requirements			
d	Identify key energy indicators			
e	Communicate comments to design team			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
A	**Defining Project Objectives**			
3	Develop Internal Project Plan			
a	Determine internal goals	• Billable rate structure • Demands on project resources • Energy analysis methods • Modeling tools and capabilities • Organization mission and goals • Sustainable design principles	• Budgeting skills • Computer skills • Engineering skills • Math skills • Project management skills • Time estimating	• Computer(s) • Gantt chart • Project management software • Spreadsheet software
b	Establish modeling budget			
c	Establish project staffing			
d	Establish project schedule			
e	Define key deliverables			
f	Assess limits of study			
4	Research Codes, Standards, and Protocols			
a	Identify codes, standards, and protocols	• Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • HVAC design • Lighting design	• Ability to interpret code, standard and protocol language • Computer skills • Critical thinking • Engineering skills • Math skills • Research skills	• Code compliance software • Codes, standards, and protocols • Computer(s)
b	Determine compliance issues			
c	Identify energy modeling baselines			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
A	**Defining Project Objectives**			
5	Set Target Goals			
a	Identify energy efficient and renewable approaches	• Benchmark data • Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • HVAC design • Lighting design • Sustainable design principles • Thermal science (e.g., heat transfer, fluid dynamics)	• Analytical skills • Common sense • Communication skills • Computer skills • Critical thinking skills • Engineering skills • Math skills • Research skills	• Benchmark database • Building energy consumption databases • Codes, standards, and protocols • Commercial building reference models • Computer(s)
b	Assess building performance for each approach			
c	Communicate results to stakeholders			
d	Identify metrics of goals			
e	Research benchmarks			
6	Set Baselines			
a	Review baselines required for Codes, standards, and protocols	• Codes, standards, and protocols • Sustainable design principles	• Engineering skills • Math skills • Technical judgment	• Codes, standards, and protocols
b	Identify additional baselines			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
A	**Defining Project Objectives**			
7	Select Analysis Method			
a	Determine modeling needs	• Building design and construction process • Daylighting design • Electrical design • Energy analysis methods • HVAC design • Lighting design • Modeling tools and capabilities • Sustainable design principles • Thermal science (e.g., heat transfer, fluid dynamics)	• Analytical skills • Comparative analysis skills • Engineering skills • Math skills • Physics	• Codes, standards, and protocols • Industry reference materials • Online forums • Software user guides
b	Identify limitations of tools			
c	Align project requirements with available tools			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Gathering Data**			
1	Define Modeling Data Requirements			
a	Compile data requirements of the selected tools	• Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • Energy analysis methods • HVAC design • Lighting design • Modeling tools and capabilities • Sustainable design principles • Thermal science (e.g., heat transfer, fluid dynamics)	• Computer skills • Data analytic skills • Detail-oriented • Engineering skills • Math skills • Organizational skills • Physics	• Building energy consumption database • Codes, standards, and protocols • Computer(s) • Energy knowledge base • Spreadsheet software
b	Identify data sources			
c	Identify data translation			
d	Catalog inputs			
e	Prepare checklist			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Gathering Data**			
2	Compile Resources			
a	Research literature and reference materials	• Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • HVAC design • Lighting design • Structure of utility tariffs • Sustainable design principles • Weather data types	• Computer skills • Data processing • Engineering skills • Math skills • Organizational skills • Physics • Research skills	• Computer(s) • Utility bill data/rate structure • Weather file conversion tools • Weather databases
b	Review design documentation			
c	Reference energy knowledge base			
d	Identify utility rates			
e	Obtain weather files			
3	Resolve Data Gaps			
a	Identify data gaps	• Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • HVAC design • Lighting design • Structure of utility tariffs • Sustainable design principles • Weather data types	• Ability to interpret design documentation • Communication skills • Computer skills • Engineering skills • Math skills • Patience • Persistence • Physics	• Computer(s) • Energy modeling software • Spreadsheet software
b	Request missing data			
c	Document assumptions for missing data			
d	Document resources			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Gathering Data**			
4	Collect On-site Data (existing building)			
a	Develop onsite data collection plan	• Building design and construction process • Building operations • Codes, standards, and protocols • Daylighting design • Electrical design • HVAC design • Lighting design • Safety • Structure of utility tariffs • Sustainable design principles	• Ability to recognize field conditions • Engineering skills • Field engineering skills • Math skills • Observation skills • Physics • Safety conscious	• Anemometer • Building leakage test equipment • CO_2 sensor • Current meter • Data logger • dB meter • Digital camera • Humidity sensors • Infrared/laser thermometer • Light meter • Power meter • Thermal imaging camera • Volt meter
b	Determine lighting power			
c	Assess plug loads			
d	Assess HVAC system			
e	Assess building envelope characteristics			
f	Catalog equipment			
g	Perform spot/short term measurements			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Gathering Data**			
5	Assess Existing Conditions (existing building)			
a	Review collected onsite data	• Indoor air quality • Mechanical noise • Structure of utility tariffs • Survey instruments • Thermal comfort • Visual comfort	• Ability to interpret building design documentation • Ability to interpret measured data • Ability to interpret survey data • Computer skills • Communication skills • Engineering skills • Math skills • Observation skills • Physics	• Computer(s) • Data visualization tools • Energy accounting software • Spreadsheet software • Survey tools
b	Interview building operator(s)			
c	Conduct occupant surveys			
d	Review existing utility bills			
e	Review as-built drawings			
f	Review measured data			
C	**Specifying Baseline Building**			
1	Recognize Baseline Methodology			
a	List building descriptors	• Codes, standards, and protocols • HVAC design • Space conditioning types	• Ability to manage large amounts of data • Engineering skills • Logical thinking • Math skills • Physics	• Codes, standards, and protocols • Modeling standards and guidelines
b	Identify neutral building descriptors (e.g., climate zone, utility rates)			
c	Classify space conditioning types			
d	Specify baseline zoning			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
C	**Specifying Baseline Building**			
2	Specify Baseline Building Envelope System			
a	Identify climate zone	• Building design and construction process • Codes, standards, and protocols • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to interpret building diagrams/ drawings • Ability to manage large amounts of data • Engineering skills • Logical thinking • Math skills • Physics	• BIM • Codes, standards, and protocols • CAD software • Modeling standards and guidelines
b	Specify surface adjacencies			
c	Determine fenestration area(s)			
d	Determine opaque construction assemblies			
e	Specify surface reflectance/emittance			
f	Determine fenestration constructions			
g	Specify below grade constructions			
h	Specify baseline infiltration			
3	Specify Baseline Lighting System			
a	Define daylighting area(s)	• Building design and construction process • Building electrical systems • Codes, standards, and protocols • Control systems • Daylighting design • Electrical design • Lighting design • Visual comfort	• Ability to interpret building diagrams/ drawings • Ability to manage large amounts of data • Engineering skills • Logical thinking • Math skills • Physics	• Codes, standards, and protocols • Modeling standards and guidelines
b	Calculate lighting power by thermal block			
c	Specify schedules			
d	Specify controls			
e	Specify lighting type			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
C	**Specifying Baseline Building**			
4	Specify Baseline HVAC System			
a	Determine system type	• Building design and construction process • Codes, standards, and protocols • HVAC controls • HVAC design • Thermal comfort • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to interpret building diagrams/ drawings • Ability to manage large amounts of data • Engineering skills • Logical thinking • Math skills • Physics	• Codes, standards, and protocols • Modeling standards and guidelines • Psychrometric charts
b	Specify system components			
c	Specify system controls			
d	Specify component efficiencies			
e	Specify system operating conditions			
f	Identify system sizing requirements			
g	Specify transmission losses			
h	Specify schedules			
5	Specify Baseline Domestic Water System			
a	Determine system type	• Building design and construction process • Codes, standards, and protocols • Plumbing design • Service water heating • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to interpret building diagrams/ drawings • Engineering skills • Logical thinking • Math skills • Physics	• Codes, standards, and protocols • Modeling standards and guidelines
b	Identify component type efficiencies			
c	Specify transmission losses			
d	Identify system sizing requirements			
e	Specify schedules			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
C	**Specifying Baseline Building**			
6	Specify Baseline Process Loads			
a	Identify energy type/fuel source	• Building design and construction process • Building electrical systems • Codes, standards, and protocols • Specialized building systems • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to interpret building diagrams/ drawings • Ability to manage large amounts of data • Engineering skills • Logical thinking • Math skills • Physics	• Codes, standards, and protocols • Modeling standards and guidelines
b	Specify peak load			
c	Specify schedules			
d	Specify how process load impacts thermal block			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
D	**Developing Project Alternatives with Design Team**			
1	Brainstorm Facility Improvement Measures			
a	Perform climate analysis	• Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • Energy analysis methods • HVAC design • Indoor air quality • Innovative technologies • Lighting design • Modeling tools and capabilities • Sustainable design principles • Thermal comfort • Thermal science (e.g., heat transfer, fluid dynamics) • Visual comfort	• Analytical skills • Communication skills • Creative • Engineering skills • Logical thinking • Math skills • Physics • Research skills	• Knowledge database • Technical journals
b	Analyze energy end-use breakdowns			
c	Develop passive load reduction strategies			
d	Develop internal load reduction strategies			
e	Investigate HVAC system alternatives			
f	Investigate daylighting opportunities			
g	Develop active load reduction strategies			
h	Develop process load reduction strategies			
i	Investigate renewable opportunities			
j	Investigate HVAC controls strategies			
k	Investigate lighting control strategies			
l	Investigate existing system operations			
m	Correct operational deficiencies			
n	Investigate IEQ improvements			
o	Generate facility improvement recommendations			
p	Discuss recommendations with owner and design team			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
D	**Developing Project Alternatives with Design Team**			
2	Package Measures into Project Alternatives			
a	Evaluate integrative design issues	• Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • Energy analysis methods • HVAC design • Indoor air quality • Innovative technologies • Lighting design • Modeling tools and capabilities • Sustainable design principles • Thermal comfort • Thermal science (e.g., heat transfer, fluid dynamics) • Visual comfort	• Computer skills • Critical thinking • Engineering skills • Math skills • Organizational skills • Physics • Whole systems thinking	• Computer(s) • Spreadsheet software • Word processing software
b	Evaluate facility improvement measure synergies			
c	Develop project alternatives			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
D	**Developing Project Alternatives with Design Team**			
3	Identify Supplemental Modeling Requirements			
a	Identify gaps in selected tool	• Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • Energy analysis methods • HVAC design • Indoor air quality • Innovative technologies • Lighting design • Modeling tools and capabilities • Sustainable design principles • Thermal comfort • Thermal science (e.g., heat transfer, fluid dynamics) • Visual comfort	• Ability to manage large amounts of data • Computer skills • Constructing abstract models • Critical thinking skills • Engineering skills • Logical thinking • Math skills • Physics	• Computer(s) • Modeling tool documentation/user guide • Modeling tools/software • Reference material/tables • Spreadsheet software
b	Develop supplemental calculations			
c	Identify additional tools			
d	Validate preliminary procedures			
e	Update data inputs			
4	Collect Incremental Costs			
a	Provide project alternatives to cost estimator	• Cost estimating • Economics • Industry rules of thumb for job costing	• Communication skills • Computer skills • Research skills	• Computer(s) • Cost estimating databases
b	Research costs using published database			
c	Verify scope of costs			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
1	Divide Building into Thermal Blocks			
a	Identify HVAC control zones	• Building design and construction process • Codes, standards, and protocols • Daylighting design • Electrical design • HVAC design • Lighting design • Sustainable design principles • Thermal science (e.g., heat transfer, fluid dynamics) • Weighted averages	• Ability to interpret design documentation • Ability to manage large amounts of data • Comparative analysis skills • Computer skills • Critical thinking skills • Engineering skills • Math skills • Physics	• Codes, standards, and protocols • Computer(s) • CAD software • Energy analysis tool • Spreadsheet software • Word processing software
b	Classify zone properties (e.g., occupancy profiles, lighting controls, ventilation)			
c	Find similarities			
d	Define thermal blocks			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
2	Specify Simulation Parameters			
a	Specify time steps	• Convergence techniques • Custom weather files • Energy analysis methods • Modeling tools and capabilities • Numerical methods • Psychrometrics	• Ability to interpret weather file structure • Ability to manage large amounts of data • Analytical skills • Computer skills • Critical thinking skills • Engineering skills • Math skills • Physics	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Psychrometric charts • Spreadsheet software • Unit conversion software • Weather databases • Weather stations • Word processing software
b	Specify the run period			
c	Specify convergence criteria			
d	Specify weather files			
e	Specify design day conditions			
f	Translate data into input parameters			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
3	Specify Site Conditions			
a	Specify surrounding features that impact the model (e.g., nearby buildings, water bodies)	• Airflow analysis • Building physics • Computational fluid dynamics • Energy analysis methods • Ground heat transfer • Sustainability design principles • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to interpret design documentation • Ability to manage large amounts of data • Computer skills • Critical thinking skills • Engineering skills • Logical thinking • Math skills • Physics • Site Survey skills	• CFD software • Codes, standards, and protocols • Computer(s) • Energy analysis tools • Energy simulation tools • Pre-processing tools (whole building energy modeling) • Satellite imaging tools • Spreadsheet software • Water utility data • Word processing software
b	Specify ground radiative properties			
c	Specify terrain parameters			
d	Specify ground temperatures			
e	Specify municipal inlet temperatures			
f	Specify wind and air properties with elevation			
g	Translate data into input parameters			
4	Construct Model Geometry			
a	Simplify building geometry	• Building design and construction process • Energy analysis methods • Geometry • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to interpret design documentation • Ability to manage large amounts of data • Computer skills • Data reduction • Drafting skills • Engineering skills • Math skills • Physics • Spatial skills	• CAD software • Codes, standards, and protocols • Computer(s) • Energy analysis tools • Energy simulation tools • Engineering/architectural scale • Spreadsheet software • Word processing software
b	Process and import geometry			
c	Input thermal zones			
d	Specify surfaces defining thermal block			
e	Specify openings (windows, doors, skylights)			
f	Specify shading for each opening			
g	Specify adjacencies			
h	Verify geometry data			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
5	Build Opaque Constructions			
a	Define materials properties	• Building design and construction process • Energy analysis methods • Ground heat transfer • Psychrometrics • Thermal resistance networks • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to manage large amounts of data • Computer skills • Critical thinking skills • Engineering skills • Logical thinking • Math skills • Physics	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Energy simulation tool • Material databases • Moisture transport software • Spreadsheet software • Two-dimensional heat transfer software • Vendor manufacturer data • Word processing software
b	Combine material into constructions			
c	Specify surface reflectance/emittance			
d	Account for air film resistances			
e	Translate data into input parameters			
6	Build Fenestration Constructions			
a	Specify thermal properties	• Building design and construction process • Energy analysis methods • Optics • Psychrometrics • Solar radiation • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to manage large amounts of data • Computer skills • Critical thinking skills • Engineering skills • Logical thinking • Math skills • Physics	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Fenestration modeling software • Spreadsheet software • Vendor manufacturer data • Word processing software
b	Specify solar optical properties			
c	Specify interior and integrated shading			
d	Translate data into input parameters			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
7	Specify Internal Lighting Loads			
a	Define lighting zones	• Building design and construction process • Color rendering index • Color temperature • Illumination levels • Lighting controls • Lighting design • Photometry • Visual comfort	• Ability to interpret design documentation • Ability to manage large amounts of data • Computer skills • Critical thinking skills • Engineering skills • Logical thinking • Math skills • Physics • Research skills	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Lighting analysis tools • Lighting rendering tools • Lighting standards and guidelines • Simulation tool • Spreadsheet software • Vendor manufacturer data • Word processing software
b	Determine input power for lighting fixtures			
c	Calculate lighting power			
d	Specify lighting schedules (e.g., ambient, task)			
e	Specify lighting controls			
f	Specify heat transfer properties of luminaires			
g	Translate data into input parameters			
8	Specify Occupancy Loads			
a	Determine peak occupancy by thermal block	• Building design and construction process • Occupant behavior • Psychrometrics • Thermal comfort • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to interpret design documentation • Ability to manage large amounts of data • Computer skills • Critical thinking skills • Engineering skills • Logical thinking • Math skills • Physics • Research skills	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Occupancy simulation tool • Reference material/tables • Spreadsheet software • Word processing software
b	Assign schedules			
c	Specify sensible and latent heat gain per occupant			
d	Specify thermal comfort conditions			
e	Translate data into input parameters			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
9	Specify Process Loads			
a	Identify process loads (e.g., exempt lighting, plug loads, elevators)	• Building design and construction process • Commercial refrigeration • Equipment operating modes • Food service • HVAC design • Occupant behavior • Plug loads • Psychrometrics • Thermal science (e.g., heat transfer, fluid dynamics) • Vertical transportation	• Ability to interpret design documentation • Ability to manage large amounts of data • Analytical skills • Computer skills • Engineering skills • Math skills • Physics • Research skills	• Codes, standards, and protocols • Computer(s) • Databases • Energy analysis tool • Reference material/tables • Spreadsheet software • Vendor manufacturer data • Word processing software
b	Identify peak load			
c	Assign schedules per load			
d	Assign load to thermal block			
e	Specify sensible and latent heat gain			
f	Translate data into input parameters			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
10	Specify Infiltration Loads			
a	Select infiltration method	• Air leakage testing • Airflow analysis • Building design and construction process • Computational fluid dynamics • Psychrometrics • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to interpret blower door data • Ability to interpret design documentation • Ability to manage large amounts of data • Analytical skills • Computer skills • Engineering skills • Math skills • Physics • Research skills	• Airflow analysis tools/software • Codes, standards, and protocols • CFD software • Computer(s) • Energy analysis tool • Reference material/tables • Spreadsheet software • Word processing software
b	Specify data as required by method			
c	Assign infiltration schedules			
d	Translate data into input parameters			
11	Specify Schedules			
a	Identify the day type	• Building occupancy patterns • Energy analysis methods	• Ability to interpret metered data • Ability to manage large amounts of data • Analytical skills • Computer skills • Math skills • Temporal awareness	• Calendar • Codes, standards, and protocols • Computer(s) • Energy analysis tool • Spreadsheet software • Word processing software
b	Identify the seasons			
c	Specify holidays			
d	Specify daylight saving period			
e	Assign a 24 hour profile to each day type			
f	Create run period schedules			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
12	Specify Ventilation			
a	Review ventilation requirements	• HVAC design • Indoor air quality	• Ability to manage large amounts of data • Computer skills • Engineering skills • Logical thinking • Math skills • Physics	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Spreadsheet software • Word processing software
b	Calculate required ventilation flow rates			
c	Select ventilation modeling method			
d	Specify ventilation schedules			
e	Translate data into input parameters			
13	Develop HVAC Systems			
a	Specify distribution systems	• Building design and construction process • Computational fluid dynamics • District energy • Energy analysis methods • HVAC controls • HVAC design • Psychrometrics • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to manage large amounts of data • Analytical skills • Computer skills • Engineering skills • Math skills • Physics • Time management skills	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Spreadsheet software • Vendor manufacturer data • Word processing software
b	Specify primary system components (e.g., cooling tower, chiller, boiler)			
c	Specify secondary system components (e.g., fans, coils)			
d	Specify zone level components (e.g., VAV box, FCU, baseboards)			
e	Specify controls			
f	Specify schedules			
g	Translate data into input parameters			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
14	Specify Service Hot Water Loads/Systems			
a	Calculate peak demand	• Building design and construction process • Energy analysis methods • HVAC controls • HVAC design • Plumbing design • Thermal science (e.g., heat transfer, fluid dynamics)	• Ability to manage large amounts of data • Analytical skills • Computer skills • Engineering skills • Math skills • Physics	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Spreadsheet software • Vendor manufacturer data • Word processing software
b	Specify controls			
c	Specify schedules			
d	Specify equipment			
e	Specify distribution system			
f	Translate data into input parameters			
15	Specify On-site Generation Systems			
a	Identify system components	• Biomass • Co-generation • Energy analysis methods • PV • Rebates and incentives • Solar thermal • Storage systems (e.g., thermal, energy) • Sustainable design principles • Thermal science (e.g., heat transfer, fluid dynamics) • Utility rate structures • Wind power	• Ability to manage large amounts of data • Analytical skills • Computer skills • Engineering skills • Math skills • Physics • Research skills • Whole systems thinking	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • On-site generation modeling software • Spreadsheet software • Vendor manufacturer data • Weather databases • Word processing software
b	Identify modeling method			
c	Translate data into input parameters			
d	Input model parameters			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
16	Specify Performance Curves			
a	Collect performance data	• Energy analysis methods • HVAC design • Regression analysis	• Ability to interpret measured data • Ability to manage large amounts of data • Analytical skills • Math skills • Research skills • Computer skills	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Equipment selection tools • Spreadsheet software • Vendor manufacturer data • Word processing software
b	Process data			
c	Assign curves to equipment			
17	Specify Control Sequences			
a	Define control set points	• BAS • Building design and construction process • Control algorithms • Control systems • Energy analysis methods • HVAC design	• Ability to interpret control diagrams and sequences • Ability to manage large amounts of data • Analytical skills • Computer skills • Engineering skills • Logical thinking • Math skills • Physics	• Building system control vendor • Codes, standards, and protocols • Computer(s) • Energy analysis tool • Spreadsheet software • Vendor manufacturer data • Word processing software
b	Review BAS sequences			
c	Define setbacks and adjustments			
d	Identify method for modeling control sequences			
e	Model controls			
f	Specify schedules to reflect control sequences			
g	Translate data into input parameters			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
18	Specify Exterior Loads (loads that do not affect building heat balance)			
a	Identify exterior loads	• Building design and construction process • Energy analysis methods • Light pollution • Lighting design • Motors • Open garage ventilation fans • Photometric controls • Time clock controls	• Ability to manage large amounts of data • Analytical skills • Computer skills • Engineering skills • Math skills	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Spreadsheet software • Vendor manufacturer data • Word processing software
b	Calculate peak loads			
c	Specify controls			
d	Specify schedules			
e	Translate data into input parameters			
19	Integrate Supplemental Customized Calculations			
a	Review supplemental calculations	• Building physics • Energy analysis methods • Modeling tools and capabilities	• Ability to manage large amounts of data • Computer skills • Critical thinking skills • Logical thinking	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Spreadsheet software • Vendor manufacturer data • Word processing software
b	Revise model to incorporate supplemental calculations			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Constructing Models**			
20	Specify Utility Rates			
a	Identify project utilities (e.g., electricity, natural gas, water)	• Block charges • Consumption charge • Demand charge • District energy • Emission coefficients • Energy analysis methods • Fuel escalation charges • Power factor • Ratchet charges • Source to site conversion • Time of use • Utility rate structures	• Ability to interpret utility tariffs • Ability to manage large amounts of data • Analytical skills • Computer skills • Engineering skills • Math skills	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Regional utility rates • Spreadsheet software • Utility bill data/rate structure • Word processing software
b	Translate data into input parameters			
c	Specify schedules and rates			
21	Create Models that Reflect Project Alternatives and Baselines			
a	Identify input changes required to model project alternatives	• Energy analysis methods • Modeling tools and capabilities	• Ability to manage large amounts of data • Computer skills • Critical thinking skills • Logical thinking • Time management	• Codes, standards, and protocols • Computer(s) • Energy analysis tool • Spreadsheet software • Word processing software
b	Identify compliance modifications			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
F	**Evaluating Model Results**			
1	Run Simulations			
a	Perform simulation	• Building design and construction process • Calculation algorithms • Design metrics • Thermal science (e.g., heat transfer, fluid dynamics)	• Computer skills • Engineering skills • Math skills • Physics	• Computer(s) • Energy simulation tools • Modeling tools/software
b	Check for errors			
c	Troubleshoot errors			
2	Perform Quality Control			
a	Verify reasonableness of inputs	• Building design and construction process • Calculation algorithms • Statistical methods • Thermal comfort • Thermal science (e.g., heat transfer, fluid dynamics) • Visual comfort	• Comparative analysis skills • Computer skills • Engineering skills • Math skills • Physics	• Building energy consumption databases • Codes, standards, and protocols • Computer(s) • Data visualization tools/software • File comparison software • Statistical and analytical tools
b	Compare inputs and outputs			
c	Confirm neutral building descriptors			
d	Compare results to benchmarks			
e	Compare results to engineering checks			
f	Resolve unmet load hours			
g	Perform sensitivity analysis			
3	Calibrate Model Against Measured Data			
a	Set up target accuracy range	• Building design and construction process • Calculation algorithms • Electrical design • Energy disaggregation • HVAC design • Lighting design • Statistical analysis	• Ability to interpret measured data • Computer skills • Data analytic skills • Engineering skills • Math skills • Physics	• Computer(s) • Energy simulation tools • Modeling tools/software
b	Identify model calibration data			
c	Identify upper and lower bounds on assumed inputs			
d	Find combinations of model data that achieve target			
e	Select most suitable calibration sets			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
F	**Evaluating Model Results**			
4	Compare Project Alternatives			
a	Compare results to project objectives	• Building design and construction process • Environmental science • Sustainable design principles • Thermal comfort • Thermal science (e.g., heat transfer, fluid dynamics) • Visual comfort	• Comparative analysis skills • Computer skills • Engineering skills • Math skills • Physics	• Computer(s) • Greenhouse gas emission calculators • Spreadsheet software
b	Perform emissions inventory			
c	Identify non-energy benefits (IEQ)			
5	Perform Economic Analysis			
a	Select method of economic analysis	• Cost estimating • Decision-making criteria • Engineering economics • Financial analysis • Incentive programs • Utility rate structures	• Computer skills • Engineering skills • Math skills • Research skills	• Computer(s) • Energy accounting software • Engineering economic reference tables • Life cycle cost software • Public economic data • Reference material/tables • Spreadsheet software
b	Identify analysis parameters (e.g., discount rate, inflation rate)			
c	Input project and energy costs into economic model			
d	Perform calculations			
e	Develop financial indicators			
f	Perform sensitivity analysis			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
F	**Evaluating Model Results**			
6	Develop Recommendations			
a	Evaluate results from economic analysis	• Control systems • Fenestration technologies • HVAC design • Lighting design • Sustainable design principles • Thermal science (e.g., heat transfer, fluid dynamics)	• Common sense • Communication skills • Comparative analysis skills • Computer skills • Listening skills • Math skills • Project management skills	• Computer(s) • Word processing software
b	Evaluate results from energy analysis			
c	Compare results to project goals			
d	Prepare recommendations			
G	**Communicating Analysis Results**			
1	Create Report			
a	Summarize results of individual measures	• Technical language	• Ability to manage large amounts of data • Communication skills • Computer skills • Engineering skills • Math skills	• Computer(s) • Graphing software • Publication software
b	Summarize results of project alternatives			
c	Document model assumptions			
d	Highlight critical elements			
e	Detail recommendations			
2	Guide Decision Making of Stakeholders			
a	Present results to stakeholders	• Fenestration technologies • HVAC design • Sustainable design principles	• Computer skills • Engineering skills • Facilitation skills • Math skills • Project management skills	• Computer(s) • Presentation software • Spreadsheet software
b	Obtain feedback			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
G	**Communicating Analysis Results**			
3	Complete Compliance Documentation			
a	Identify reporting requirements	• Calculation algorithms • Compliance requirements • Software	• Computer skills • Engineering skills • Math skills • Organizational skills	• Compliance packages • Computer(s) • Modeling tools/software
b	Extract inputs and outputs			
c	Prepare supporting documentation			
4	Maintain Energy Knowledge Base			
a	Identify lessons learned	• Organization of database	• Ability to manage large amounts of data • Computer skills • Data analytic skills • Math skills	• Computer(s) • Energy knowledge base
b	Update internal database			
H	**Implementing Project**			
1	Review Construction Documents			
a	Verify implementation of recommendations	• Architectural design • Building design and construction process • Control systems • Daylighting design • Electrical design • HVAC design • Lighting design	• Ability to interpret design documentation • Communication skills • Computer skills • Engineering skills • Math skills	• CAD software • Computer(s) • Construction project management software
b	Provide comments to design team			
2	Analyze Utility Bills			
a	Collect utility bills	• Electrical design • Statistical analysis • Utility rate structures	• Comparative analysis skills • Computer skills • Engineering skills • Math skills	• Computer(s) • Energy accounting software • Spreadsheet software
b	Compare bills to model results			
c	Conduct statistical analysis			

Table 7 (Continued): DACUM Chart for Commercial Building Energy Modelers

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
H	**Implementing Project**			
3	Conduct M&V			
a	Develop M&V plan/method	• Building control systems • Deviation reports • M&V protocols • Metering and data logging • Safety • Sensor technologies and reliability	• Ability to manage large amounts of data • Computer skills • Engineering skills • Field engineering skills • Math skills • Physics	• Building design documentation • Computer(s) • Data logger • Digital camera • Sensors • Spreadsheet software
b	Verify installation of M&V equipment			
c	Collect M&V data			
d	Analyze M&V data			
e	Recommend operational changes			
4	Share Lessons Learned			
a	Develop case studies	• Common industry publications	• Communication skills • Computer skills • Critical thinking skills • Engineering skills • Math skills • Physics • Technical judgment	• Codes, standards, and protocols • Computer(s) • Energy knowledge base • Professional literature • Publication software
b	Write articles and papers			

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