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Commercial Workforce Credentialing Council

Job Task Analysis Building Energy Auditor

November 2013 – December 2014

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Job Task Analysis

Building Energy Auditor

November 2013 — December 2014

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Executive Summary

This report describes the process for and results of a comprehensive Job Task Analysis (JTA) of Energy Auditors. This study was performed by Professional Testing, Inc., on behalf of the National Renewable Energy Laboratory. The competency (domains, tasks, and associated knowledge) list, which defines the work performed by practitioners, was initially developed by a representative panel of practitioners during a meeting held February 3–5, 2014, in Orlando, Florida. After the job tasks and associated knowledge and skills were identified, a validation survey was conducted of the findings of the JTA, and the results of the validation study were reviewed by a representative panel of practitioners during a conference call held on May 29, 2014. The panel finalized the JTA and examination blueprints for the Energy Auditor credential scheme based on the survey results.

Acronyms

CHP	Combined Heat and Power
DACUM	Developing a Curriculum
DOE	U.S. Department of Energy
EEM	Energy Efficiency Measures
EHS	Environmental Health and Safety Plan
EPA	U.S. Environmental Protection Agency
HVACR	Heating, Ventilating, Air Conditioning and Refrigeration
IEQ	Indoor Environmental Quality
JTA	Job Task Analysis
M&V	Measurement and Verification
NIBS	National Institute of Building Sciences
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
PV	Photovoltaic
SD	Standard deviation
SEM	Standard error of the mean
SME	Subject matter expert
TMY	Typical Meteorological Year

Table of Contents

List of Figures

List of Tables

1 Introduction

The National Renewable Energy Laboratory (NREL), in conjunction with the National Institute of Building Sciences (NIBS) and the U.S. Department of Energy (DOE), led a study to identify the critical duties and tasks required of an Energy Auditor. Professional Testing, Inc., used the DACUM (Developing a Curriculum) process to conduct a Job Task Analysis (JTA) and identify the competencies.

A panel of subject matter experts (SMEs) was selected by NIBS and convened by Professional Testing, Inc., for a 3-day meeting held February 3–5, 2014, in Orlando, Florida. The competencies identified during the meeting were then validated via a survey. This report reflects the completion and results of the study, and is organized with section 2 containing the proposed final content outline, and the later sections containing the details of the JTA development process, including results of the validation survey.

2 Final Building Energy Auditor DACUM Job/Task Analysis

2.1 Building Energy Auditor Job Description

The Commercial Building Energy Auditor is an energy solutions professional who assesses building systems and site conditions; analyzes and evaluates equipment and energy usage; and recommends strategies to optimize building resource utilization.

2.2 Job/Task Analysis DACUM Chart for Building Energy Auditor

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

Table 1. Duties and Tasks of Building Energy Auditor

Duties and Tasks				Final Weight	Final Items
A			**Communicating with Stakeholders**	**5%**	**5**
	1		Identify the owner's project team	1%	1
	2		Review the scope and process with the client	4%	4
B			**Developing the Action Plan**	**7%**	**7**
	1		Conduct pre-audit activities	2%	2
	2		Generate preliminary list of systems and assemblies to be audited	2%	2
	3		Determine audit tools and forms	1%	1
	4		Determine project schedule	1%	1
	5		Identify safety and access requirements of the facility	1%	1
C			**Conducting Pre-site Visit Data Collection Activities**	**4%**	**4**
	1		Obtain utility information	1%	1
	2		Obtain facility data from point of contact	1%	1
	3		Gather historical weather data	2%	2
D			**Collecting Data On-site**	**21%**	**21**
	1		Obtain information from facility staff	2%	2
	2		Obtain information from facility occupants	2%	2
	3		Assess the building envelope	7%	7
	4		Assess building systems and components	10%	10
E			**Analyzing Building Performance Data**	**25%**	**25**
	1		Establish energy and cost baseline	6%	6
	2		Establish benchmarks	6%	6
	3		Disaggregate the energy end use breakdown	13%	13
F			**Identifying Opportunities for Improving Building Performance**	**30%**	**30**
	1		Identify deviations from best practices	6%	6
	2		Determine energy impact of each measure	10%	10
	3		Estimate implementation cost	4%	4
	4		Conduct an economic analysis	10%	10
G			**Producing the Deliverable**	**8%**	**8**
	1		Write a summary audit report	8%	8

Table 2. Areas of Specialized Knowledge Required of Building Energy Auditor

Areas of Specialized Knowledge	
Air compressors	Audit processes and tasks
Benchmarking	Building automation control systems and programming
Building physics	Building pressurization
Building sciences	Building systems engineering concepts and principles (See Table 3)
Components of building and process systems and assemblies	Data collection protocols
Electrical power systems	Energy efficiency measures (EEM) and economics
Energy calculations (e.g. energy modeling)	Engineering economics
Financial analysis methodologies and thresholds (e.g. life cycle costs analysis, ROI)	General building construction materials
Greenhouse gas calculations	Heat transfer
Heating and cooling degree days and balance point temperature	Historic building practices
IEQ	Impact of age of building on building systems
Industry accepted standards, codes and guidelines	Industry equipment
Industry terminology	M&V methodologies
Maintenance procedures and roles	Measurement equipment (current transformers, data loggers, etc.) and techniques
Minimum required time period of utility data	Onsite energy generation (CHP, PV, wind, thermal, etc.)
Operations within the facility	Potential environmental, health, and safety (EHS) hazards and risks
Process systems and controls	Rebates and incentives
Safety practices	Sampling protocols and procedures
Solar mapping	Systems interactions and integration
Types of audits (level 1, 2, or 3, etc.)	Typical energy analysis methodologies
Typical energy usage by building type	Typical percentage of end usage by occupancy type
Understand available data types for weather (bin data, hourly data, TMY, etc.)	Understanding of engineering practices and principles
Understanding of industry best practices for various building systems	Understanding of utility bill information
Understanding of what an energy audit is	Utility rate structures and schedules
When a building needs to be "tuned up" versus new installations	Window types

Table 3. Areas of Building Systems Knowledge Required of Building Energy Auditor

Areas of Building Systems Knowledge
Air compressors
Building automation control systems and programming
Building HVACR systems
Building interior and exterior lighting fixtures and controls
District energy
Electrical power systems
Low temperature refrigeration systems
Onsite energy generation (CHP, PV, wind, thermal, etc.)
Process systems and controls
Service hot water and control systems
Water distribution and control systems

Table 4. Areas of General Knowledge Required of Building Energy Auditor

Areas of General Knowledge
Calculations
Perform simple math operations of addition
Perform simple math operations of subtraction
Perform simple math operations of multiplication
Perform simple math operations of division
Use a calculator
Compare numbers
Figure averages
Perform mathematical operations with fractions
Perform mathematical operations with decimals
Perform math operations using single and multiple digit numbers
Change numbers from percentages into decimals and back
Transfer number sequences from a source into a column
Solve ratio problems
Solve percent problems
Perform math operations using signed (positive and negative) numbers
Multiply and factor algebraic expressions
Collect information to solve a problem
Solve formula calculations with one unknown
Change numbers from fractions into decimals and back
Make rough estimates
Solve problems with graphs
Solve formula calculations with more than one unknown
Perform math operations using exponential numbers
Measure angles
Solve right triangle problems using Pythagorean theorem
Perform angular calculations
Solve right triangle trigonometry problems
Solve oblique triangle problems
Solve triangle-circle problems
Solve angle-circle problems
Solve oblique triangle trigonometry problems
Solve compound angle problems
Basic Measurement
Convert measurements from one unit to another (English to Metric, etc.)
Record measurements, using appropriate unit notations (feet, yards, etc.)
Measure area (square inches, square centimeters, etc.)
Read and use the scale of a drawing
Read measurements taken with common measuring tools

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

Table 5. Skills and Abilities Required of Building Energy Auditor

Skills and Abilities	
Ability to communicate technical information to others	Ability to comprehend technical documentation
Ability to convert units	Ability to determine tools needed for an audit
Ability to recognize abnormalities	Ability to interpret scheduling tools (Gantt chart, milestone, etc.)
Ability to interpret thermography	Ability to interpret utility bills, rate structures and utility contracts
Ability to use conversion factors	Analytical skills
Basic math skills	Basic engineering skills
Computer skills	Construction cost estimating skills
Data collection skills	Decision making ability
Detail-oriented	Diagnostic abilities
Documentation skills	Interpersonal skills
Interviewing skills	Listening skills
Normalizing data	Observational skills
Organizational skills	Problem solving skills
Programming skills	Project management skills
Quantitative analysis skills	Reading ability
Technical writing skills	Troubleshooting skills
Verbal communication skills	Word processing skills
Written communication skills	

Table 6. Attitudes Required of Building Energy Auditor

Attitudes			
1	Analytic	25	Pride in job
2	Detail-oriented	26	Work efficiently (time)
3	Critical thinker	27	Work in teams
4	Professional	28	Confident
5	Accurate/Precise	29	Meticulous
6	Common sense	30	Persistent
7	Free of substance abuse	31	Respectful
8	Organized	32	Team player
9	Dependable	33	Adaptable/Flexible
10	Quality focused	34	Patience
11	Focused	35	Work efficiently (resources)
12	Honest	36	Customer-oriented
13	Integrity	37	Multi-tasker
14	Safety conscious	38	Self-discipline
15	Cooperative	39	Courteous
16	Ethical	40	Creative
17	Good listener	41	Industrious
18	Punctual	42	Initiative
19	Responsible/accountable	43	Eager to learn new things
20	Trustworthy	44	Manage stress/pressure
21	Conscientious	45	Positive attitude
22	Goal-oriented	46	Self-control
23	Good time manager	47	Tactful
24	Lack of prejudice (bias)	48	Tolerant

Table 7. Tools, Equipment and Resources Required by Building Energy Auditor

Tools, Equipment, and Resources
Audit tools (See Table 8)
Best practices guides
Computer
Cost estimation guides
EPA Portfolio Manager
Internet
Local and federal OSHA requirements
OSHA
Personal protective equipment (PPE)
Project management software (Project, Excel, etc.)
Spreadsheet and simulation software
Standards, codes, and guidelines (See Table 9)
US Energy Information Agency database
Weather databases (NOAA, utility companies, airport, etc.)

Table 8. Audit Tools Required by Building Energy Auditor

Audit Tools	
Equipment	
Air flow measurement devices	Ballast discriminator
Black tape	Calculator
Camera	CO_2 meter
Combustion Analyzer	Compressed air/steam leak detector
Data logger	Duct Sizing tools
Flashlight	Infrared camera
Length measuring tool (tape measure, laser measure, etc.)	Light level meter
Manometer	Mirror
Non-contact thermometer	Pipe Sizer
Power measurement tools	Psychrometric measurement tool
Relative humidity sensor	Sound level meter
Stopwatch	Tachometer
Temperature sensor	Ultra sonic flow meter
Velometer	
Software	
3EPlus	AirMaster
Blast	CAD Viewer
DOE2	EERE
E-Grid	Energy Plus

Audit Tools	
Software (continued)	
EPA Portfolio manager	eQuest
FEMP BLCC (Federal Energy Management Program, Building Life Cycle Costing)	HAP - carrier
IES	MotorMaster
Open Studio	Phast (DOE tool)
Photometrics	PV Watts
Spreadsheet	Trace 700 - Trane
Transys	

Table 9. Standards, Codes, and Guidelines for Building Energy Auditor

Standards, Codes, and Guidelines
ASHRAE Standards **See ASHRAE Procedures for additional sources**
ASHRAE Standards 15 -- Safety Standards for Refrigeration Systems
ASHRAE Standards 34 -- Designation and Safety Classifications of Refrigerants
ASHRAE Standards 41.1 -- Standard Method for Temperature Measurement
ASHRAE Standards 41.7 -- Method Test for Measurement of Flow of Gas
ASHRAE Standards 55 -- Thermal Environmental Conditions for Human Occupancy
ASHRAE Standards 62.1 -- Ventilation and Acceptable Indoor Air Quality
ASHRAE Standards 90.1 -- Energy Standard for Buildings Except Low Rise Residential Buildings
ASHRAE Standards 100 -- Energy Conservation in Existing Buildings
ASHRAE Standards 105 -- Standard Method of Measuring and Expressing Building Energy Performance
ASHRAE Standards 134 -- Graphic Symbols for Heating, Ventilating, Air Conditioning and Refrigeration Systems
ASHRAE Standards 154 -- Ventilation for Cooking Operations
ASHRAE Standards 169 -- Weather Data for Building Design Standards
ASHRAE Standards 170 -- Ventilation for Health Care Facilities
ASHRAE Standards 180 -- Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems
ASHRAE Standards 189.1 -- Standard for Design of High Performance Green Buildings
ASHRAE Standards 211 (P) -- Standard for Conducting commercial Building Audits
BSR/ASHRAE/USGBC/ASPE/AWWA Standard 191(P) -- Standard for the Efficient Use of Water in Building, Site, and Mechanical Systems
ASHRAE Guides, Etc. **See ASHRAE Procedures for additional sources**
ASHRAE Guide 10 -- Interactions Affecting the Achievement of Acceptable Indoor Environments
ASHRAE Guide 11 -- Field Testing of HVAC Controls Performance
ASHRAE Guide 12 -- Minimizing the Risk of Legionellosis with Building Water Systems
ASHRAE Guide 14 -- Measurement of Energy and Demand Savings
ASHRAE Guide 22 -- Instrumentation for Monitoring of Chilled Water Plant Efficiency
ASHRAE Guide 32 -- Sustainable High Performance Operation and Maintenance
ASHRAE Guide -- Energy Efficiency Guides for Existing Commercial Buildings: Business Case
ASHRAE Guide -- Energy Efficiency Guides for Existing Commercial Buildings: Technical Case

Standards, Codes, and Guidelines
ASTM Standards
ASTM Standard E1934-10 -- Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermograph
ASTM Standard E1311-2010 -- Standard Test Methods for Minimum Temperature Detection Difference for Thermal Imaging Systems
Most current editions of:
AEE -- Handbook of Energy Audits
AEE Reference Books
American Institute of Architects -- Guideline for the Construction of Hospital and Health Care Facilities
ASHRAE -- Building Performance Metrics Best Practices
ASHRAE -- Handbooks: Fundamentals, Systems, Applications, Refrigeration
ASHRAE -- Procedures for Commercial Building Energy Audits; 2nd Editions
ASHRAE/ASPE/AWW -- Water Condition Standards
Cost Estimating Guides
ECAM (Energy Charting and Metrics)
EERE (Air Master, Motor Master, etc.)
FEMP M&V Guidelines
General OSHA Guidelines
Illuminating Engineering Society -- The Lighting Handbook
International Performance Measurement and Verification Protocol
MICA -- National Mechanical Insulation Standards
NIST -- Handbook 135 Life Cycle Costing Manual for Federal Energy Management Program

Table 10. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Communicating with Stakeholders

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Identify the owner's project team			
Conduct a meeting with the client's representative		• Computer skills • Interpersonal skills • Verbal communication skills • Written communication skills	
Create the project contact list			
Identify the responsibilities of the owner's project team members			
Determine problem resolution methodologies			
Review the scope and process with the client			
Review the scope of work with client	• Industry accepted standards, codes and guidelines • Safety practices • Understanding of what an energy audit is	• Computer skills • Interpersonal skills • Project management skills • Verbal communication skills • Written communication skills	• Computer • OSHA • Standards, codes, and guidelines (See Table 9)
Outline process of how the audit will be conducted			
Discuss contract concerns			
Discuss site specific requirements (access, safety, etc.)			
Determine schedule with client			
Discuss reporting requirements (scheduling of reporting, to whom, etc.)			

Table 11. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Developing the Action Plan

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Conduct pre-audit activities			
Read building owners objectives and criteria	• Building systems engineering concepts and	• Reading ability	• Standards, codes, and guidelines (See

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Read scope of work	principles • Components of building and process systems and assemblies • Industry accepted standards, codes and guidelines • Industry terminology • Types of audits (level 1, 2, or 3, etc.)		Table 9)
Read energy audit contract			
Identify criteria for determining success			
Review the auditor's project team roles and responsibilities			
Assign audit team based on skills required, scope of work, and staff availability			
Review final format of deliverable			
Generate preliminary list of systems and assemblies to be audited			
Read available existing technical documents and drawings	• Audit processes and tasks • Building systems engineering concepts and principles • Components of building and process systems and assemblies • Historic building practices	• Ability to comprehend technical documentation	• Standards, codes, and guidelines (See Table 9)
Determine the initial equipment to be audited			
Determine initial building assemblies to be audited			
Determine the performance parameters to be measured			
Determine audit tools and forms			
Determine methodology for energy analysis (energy model, bin data, etc.)	• Data collection protocols • Industry accepted standards, codes and guidelines • M&V methodologies • Measurement equipment (current transformers, data loggers, etc.) and techniques	• Ability to determine tools needed for an audit	• Audit tools (See Table 8) • Standards, codes, and guidelines (See Table 9)
Compile interview questions			
Select tools and equipment needed for the audit (data loggers, light meters, specialized tools, etc.)			
Develop customized tools and forms if needed			
Select forms for audits	Typical energy analysis methodologies		
Determine project schedule			
Identify tasks	• Audit processes and tasks • Types of audits (level 1, 2,	• Ability to interpret scheduling tools	• Project management software (Project,
Identify access limitations of areas in the			

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
facility	or 3, etc.)	(Gantt chart, milestone, etc.) • Organizational skills • Project management skills	Excel, etc.)
Estimate the time required to complete each task			
Determine sequence of tasks			
Create initial project schedule document			
Identify safety and access requirements for the facility			
Review site EHS plan if available	• Potential environmental, health, and safety (EHS) hazards and risks		• Local and federal OSHA requirements • Personal protective equipment (PPE)
Assess potential risks with identified tasks and type of facility			
Identify required PPE			
Verify emergency points of contact			
Arrange for site access			

Table 12. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources

Required for Conducting Pre-Site Visit Data Collection Activities

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Obtain utility information			
Request copies of actual utility bills from owners or utility company	• Energy calculations (e.g. energy modeling) • Minimum required time period of utility data • Understanding of utility bill information	• Ability to interpret utility bills, rate structures and utility contracts • Verbal communication skills • Written communication skills	• Computer • Internet • US Energy Information Agency database
Obtain utility authorization forms as required			
Obtain relevant information from the utility representative			
Obtain utility rate structures	• Utility rate structures and schedules		
Obtain utility contracts (third party suppliers, delivery company, etc.)			
Obtain information about utility incentive programs			
Verify data obtained is correct and complete			

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Obtain facility data from point of contact			
Request equipment list	• Building systems engineering concepts and principles • Components of building and process systems and assemblies	• Ability to comprehend technical documentation • Verbal communication skills • Written communication skills	• Computer • Standards, codes, and guidelines (See Table 9)
Request maintenance logs and work orders			
Request latest capital improvement plan			
Request any technical documents			
Request results of any previously completed audit reports and whether recommendations were implemented			
Request results of any previously completed, in process or planned renovations or upgrades			
Request building operating plans			
Request operating schedules			
Gather historical weather data			
Identify methodology used to normalize data	• Understand available data types for weather (bin data, hourly data, TMY, etc.)	• Normalizing data	• Weather databases (NOAA, utility companies, airport, etc.)
Determine duration and interval of data required			
Identify available weather location			
Obtain weather data			
Select methodology for filling in missing data			
Fill in the missing data			

Table 13. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Collecting Data On-site

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Obtain information from facility staff			
Interview key personnel on building systems/processes	• Building systems engineering concepts and principles	• Detail-oriented • Documentation skills • Interpersonal skills	
Interview key personnel on operational			

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
concerns Record responses Follow up on interview question responses	• Components of building and process systems and assemblies • Maintenance procedures and roles • Operations within the facility	• Interviewing skills	
Obtain information from facility occupants			
Collect information from facility occupants on physiological and psychological perceptions regarding IEQ Record responses	• IEQ • Sampling protocols and procedures	• Detail-oriented • Documentation skills • Interpersonal skills • Interviewing skills • Listening skills	
Assess the building envelope			
Conduct visual inspection (walls, roof, floors, etc.) Obtain data to estimate overall heat transfer coefficients Evaluate air-tightness Evaluate the fenestration Evaluate exterior shading Evaluate the roof Evaluate windows	• Building physics • Building pressurization • Building sciences • General building construction materials • Heat transfer • Solar mapping	• Ability to convert units • Detail-oriented • Ability to interpret thermography • Basic math skills • Observational skills	• Audit tools (See Table 8) • Standards, codes, and guidelines (See Table 9)
Evaluate interior shading Evaluate penetrations Document the observations	Window types		
Assess building systems and components			
Observe the condition and operation of the equipment Observe the condition and operation of	• Air compressors • Building automation control systems and	• Basic engineering skills • Data collection skills	• Audit tools (See Table 8) • Standards, codes,

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
building lighting fixtures, controls and schedules	programming • Building systems engineering concepts and principles • Components of building and process systems and assemblies • Electrical power systems • IEQ • Onsite energy generation (CHP, PV, wind, thermal, etc.) • Process systems and controls • Systems interactions and integration	• Detail-oriented • Documentation skills • Basic math skills • Observational skills • Programming skills	and guidelines (See Table 9)
Obtain lighting fixture count and characteristics (ballasts, amps, etc.)			
Obtain nameplate data			
Obtain water distribution system fixture count and nameplate data			
Evaluate ventilation requirements for the building			
Evaluate IEQ			
Set up collection of data and establish frequency and time period of data collection			
Obtain spot measurements using audit tools			
Compare trend data to spot measurements for validation			
Collect data			
Evaluate the accuracy of data collected			
Document observations			
Verify building and equipment operation schedules			

Table 14. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Identifying Opportunities for Improving Building Performance

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Establish energy and cost baseline			
Review collected data Synchronize data collection based on time stamp Identify factors that impact usage Build a baseline model Calibrate baseline model to data Evaluate the accuracy of baseline Apply rate structure to baseline Calibrate baseline cost to data	• Building systems engineering concepts and principles • Components of building and process systems and assemblies • Heating and cooling degree days and balance point temperature • Systems interactions and integration • Utility rate structures and schedules	• Ability to recognize abnormalities • Analytical skills • Decision making ability • Detail-oriented • Investigative skills	• Audit tools (See Table 8) • Spreadsheet and simulation software • Standards, codes, and guidelines • Weather databases (NOAA, utility companies, airport, etc.)
Establish benchmarks			
Survey benchmark sources Select appropriate benchmarks Convert data into common metric Compare performance of building to benchmark	• Benchmarking • Typical energy usage by building type	• Ability to use conversion factors	• EPA Portfolio Manager • Standards, codes, and guidelines (See Table 9)

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Disaggregate the energy end use breakdown			
Determining categories for end use Analyze data collected by system Compute energy use by system Reconcile with baseline energy use	• Building systems engineering concepts and principles • Components of building and process systems and assemblies • Systems interactions and integration • Typical percentage of end usage by occupancy type • Utility rate structures and schedules	• Ability to recognize abnormalities • Analytical skills • Decision making ability • Detail-oriented • Investigative skills	• Audit tools (See Table 8) • Spreadsheet and simulation software • Weather databases (NOAA, utility companies, airport, etc.)

Table 15. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Identifying Opportunities for Improving Building Performance

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Identify Deviations from Best Practices			
Interpret the data collected onsite and prior to the audit Verify the rate structure is correct Compare collected information to target or best practice of each system Correlate data to make comparisons with activities occurring in the building Enumerate potential energy savings opportunities Describe proposed EEM in sufficient detail to develop savings and cost	• Building systems engineering concepts and principles • Components of building and process systems and assemblies • Energy efficiency measures (EEM) and economics • Systems interactions and integration • Understanding of engineering practices and principles • Understanding of industry best practices for various building systems • When a building needs to be "tuned up" versus new installations	• Ability to recognize abnormalities • Diagnostic abilities • Problem solving skills • Troubleshooting skills	• Audit tools (See Table 8) • Best practices guides • Standards, codes, and guidelines (See Table 9)
Determine Energy Impact of Each Measure			
Input each measure into baseline tool Collect additional performance information as required Estimate impact of each measure (maintenance and energy impacts) Estimate impact of interaction among identified measures Estimate emission and greenhouse gas impact as required Identify M&V methodology as required	• Building systems engineering concepts and principles • Components of building and process systems and assemblies • Greenhouse gas calculations • Systems interactions and integration • Utility rate structures and schedules	• Ability to recognize abnormalities • Decision making ability • Detail-oriented • Investigative skills • Quantitative analysis skills	• Audit tools (See Table 8) • Spreadsheet and simulation software • Standards, codes, and guidelines (See Table 9) • Weather databases (NOAA, utility companies, airport, etc.)
Estimate Implementation Cost			
Identify material quantity for each	• Building systems	• Construction cost estimating	• Cost estimation guides

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
measure Determine labor hours for each measure Contact vendors and contractors as appropriate Incorporate rebates and incentives for each measure Estimate net cost of each measure	engineering concepts and principles • Components of building and process systems and assemblies • Industry equipment • Rebates and incentives	skills	• Standards, codes, and guidelines (See Table 9)
Conduct an Economic Analysis			
Select economic analysis methods Perform economic analysis for each measure Prioritize measures	• Engineering economics • Financial analysis methodologies and thresholds (e.g. life cycle costs analysis, ROI)		• Standards, codes, and guidelines (See Table 9)

Table 16. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Producing the Deliverable

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Write a Summary Audit Report			
Draft audit report Review audit report with client Incorporate comments into audit report Issue final audit report Present report to client as required		• Ability to communicate technical information to others • Technical writing skills • Word processing skills	• Standards, codes, and guidelines (See Table 9)

3 Examination Blueprint

The Final Proposed Examination Blueprint for Energy Auditor is shown below in Table 17. The exam blueprint identifies subject matter areas covered on a certification exam. Table 17 column headings are defined as follows:

Duties and Tasks: Description of the work

Analytical Weights: The weights calculated by taking the average of the tabulated individual ratings on frequency and importance (2 times importance plus frequency). See Section 6.2.

Holistic Weights: These are the weights calculated by taking the average the individual responses regarding the overall percentage that should be in each of the Duties and Tasks. See Section 6.2.

Final Weight: These are the weights agreed upon by the JTA committee during the post-validation study webinar. See Section 6.

Final Items: These are the quantity of items (i.e., test questions) that should be on each examination in each of the categories as agreed to by the JTA committee during the post-validation study webinar.

Table 17. Final Proposed Examination Blueprint for Energy Auditor

Duties and Tasks	Analytical Weights	Holistic Weights	Final Weights	Final Items
Communicating with Stakeholders	**9%**	**8%**	**5%**	**5**
Identify the owner's project team	4%		1%	1
Review the scope and process with the client	5%		4%	4
Developing the Action Plan	**21%**	**9%**	**7%**	**7**
Conduct pre-audit activities	5%		2%	2
Generate preliminary list of systems and assemblies to be audited	4%		2%	2
Determine audit tools and forms	4%		1%	1
Determine project schedule	4%		1%	1
Identify safety and access requirements of the facility	4%		1%	1
Conducting Pre-site Visit Data Collection Activities	**14%**	**10%**	**4%**	**4**
Obtain utility information	5%		1%	1
Obtain facility data from point of contact	5%		1%	1
Gather historical weather data	4%		2%	2
Collecting Data On-site	**18%**	**18%**	**21%**	**21**
Obtain information from facility staff	5%		2%	2
Obtain information from facility occupants	3%		2%	2
Assess the building envelope	4%		7%	7
Assess building systems and components	6%		10%	10
Analyzing Building Performance Data	**14%**	**21%**	**25%**	**25**

Duties and Tasks	Analytical Weights	Holistic Weights	Final Weights	Final Items
Establish energy and cost baseline	5%		6%	6
Establish benchmarks	4%		6%	6
Disaggregate the energy end use breakdown	4%		13%	13
Identifying Opportunities for Improving Building Performance	**19%**	**23%**	**30%**	**30**
Identify deviations from best practices	4%		6%	6
Determine energy impact of each measure	5%		10%	10
Estimate implementation cost	5%		4%	4
Conduct an economic analysis	5%		10%	10
Producing the Deliverable	**5%**	**12%**	**8%**	**8**
Write a summary audit report	5%		8%	8
	100%	100%	100%	100

To arrive at the final blueprint, the JTA committee was asked to consider the tabulated frequency and importance scales together with the holistic weights.

Respondents were asked to provide a holistic weighting to the domain areas. Based on the responses, an examination blueprint was calculated for each domain. This information appears in Table 18.

Table 18. Summary of Respondent Holistic Ratings

Domain	%
Communicating with Stakeholders	7.90%
Developing the Action Plan	8.65%
Conducting Pre-Site Visit Data Collection Activities	9.91%
Collecting Data On-Site	18.07%
Analyzing Building Performance Data	20.82%
Identifying Opportunities for Improving Building Performance	22.78%
Producing the Deliverable	11.98%

The remainder of this document describes the process for conducting the job task analysis and administering the validation survey.

4 Job Task Analysis and Survey Validation

NIBS and NREL organized a group of panelists consisting of 13 SMEs representing Energy Auditors to conduct a JTA using the DACUM methodology. The 13 experts are listed in Table 19.

Table 19. List of DACUM JTA Participants

Heather Buckberry, P.E., CEM, LEED AP BD+C, PMP **Senior Technical Project Manager**	Oak Ridge National Laboratory Oak Ridge, TN
Christopher Crall, P.E.	Consultant Gahanna, OH
John Dunlap, P.E., BEAP, HBDP, BEMP, HFDP, LEED AP	Dunlap & Partners Engineers Richmond, VA
David Eldridge Jr, P.E., BEMP, BEAP, HBDP, LEED AP BD+C **Project Manager**	Grumman/Butkus Associates Evanston, IL
H. Jay Enck, CxAP, HBDP, BEAP, FLEED AP BD+C **Chief Technology Officer**	Commissioning & Green Building Solutions, Inc. Duluth, GA
Cristian B. Harbaugh, EIT, LEED AP BD+C, BEAP **Engineer II**	H.F. Lenz Company Johnstown, PA
Jennifer King **State Program Administrator**	State of Minnesota Saint Paul, MN
Terry Niehus, P.E., CEM, CEA **President**	Cudjoebay Consulting Cudjoe Key, FL
Sonya M. Pouncy, CEM, LEED AP	Consultant Detroit, MI
David Redding, LEED AP BD+C, HBDP, BEMP	Technical Educator Seattle, WA
Shiva Subramanya, CEM **Principal**	Enpowered Solutions Santa Ana, CA
Terry E. Townsend, P.E., FASHRAE, LEED AP **President**	Townsend Engineering, Inc. Chattanooga, TN
Jon Weiskopk, P.E., CEM **Senior Engineer**	Steven Winter Associates New York, NY

The DACUM JTA meeting was facilitated by Dr. Cynthia Woodley, psychometrician, and Ms. Tracey Paschal, project manager with Professional Testing, Inc. The 3-day meeting developed a list of seven domains or duties and 22 tasks through group discussions.

4.1 Survey Development

The task list was used to build a survey that was delivered using an online mechanism. The survey consisted of two major sections: Demographic Information and Energy Auditor Tasks. The draft survey was shared with NREL/NIBS/DOE staff for initial review and then NIBS volunteered to send the survey to appropriate respondents. Appendix A includes a copy of the survey.

4.2 Survey Dissemination

NIBS sent the survey to several Energy Auditors. The survey was open for approximately 30 days in the spring of 2014 for data collection, during which time email reminders were sent. The final dataset included 270 respondents, some of whom did not complete the survey.

5 Results

All data were included in the analyses, since people who skipped a question or task rating may have done so either accidentally or because they felt that the item was not applicable to their position. The sample size is large enough (270) to allow reasonable confidence in the results. Results from the demographics questions will be presented first.

5.1 State of Primary Employment

The largest number of respondents reported working in multiple states or "other" for which they wrote in responses. The states with the largest numbers of respondents were New York (8.1%, n = 18), Texas (7.2%, n = 16), California (5.9%, n = 13), and Florida (5.0%, n = 11). Table 20 provides the summary.

Table 20. State of Employment of Respondents

State	%	#	State	%	#
Multiple States	20.7%	46	**Nevada**	0.9%	2
Other (please specify)	20.7%	46	**Oregon**	0.9%	2
New York	8.1%	18	**South Carolina**	0.9%	2
Texas	7.2%	16	**Alabama**	0.5%	1
California	5.9%	13	**Alaska**	0.5%	1
Florida	5.0%	11	**Arkansas**	0.5%	1
Michigan	4.1%	9	**Hawaii**	0.5%	1
Washington	4.1%	9	**Idaho**	0.5%	1
Colorado	3.2%	7	**Iowa**	0.5%	1
Illinois	3.2%	7	**Kansas**	0.5%	1
Maryland	3.2%	7	**Kentucky**	0.5%	1
Minnesota	3.2%	7	**Maine**	0.5%	1
Pennsylvania	3.2%	7	**Missouri**	0.5%	1
New Jersey	2.3%	5	**New Hampshire**	0.5%	1
North Carolina	2.3%	5	**North Dakota**	0.5%	1
Ohio	2.3%	5	**Vermont**	0.5%	1
Arizona	1.8%	4	**West Virginia**	0.5%	1
Tennessee	1.8%	4	**Louisiana**	0.0%	0
Virginia	1.8%	4	**Mississippi**	0.0%	0
Indiana	1.4%	3	**Montana**	0.0%	0
Massachusetts	1.4%	3	**New Mexico**	0.0%	0
Nebraska	1.4%	3	**Oklahoma**	0.0%	0
Wisconsin	1.4%	3	**Rhode Island**	0.0%	0
Connecticut	0.9%	2	**South Dakota**	0.0%	0
Delaware	0.9%	2	**Utah**	0.0%	0
Georgia	0.9%	2	**Wyoming**	0.0%	0
Answered question		**222**			

Table 21 contains a list of the write-in comments associated with “other.” Several of the write-in comments were states for which the respondents could have checked participant states. However, Table 21 highlights international locations where respondents work (yellow highlight).

Table 21. List of "Other" Write-In Comments

“Other” Write-in Comments	
Virginia	Gujarat
OH, Maryland, California	Spain
Worldwide	India
Europe	Europa, Bulgaria
Greece	Spain
Most often Illinois	France
Mexico	South Korea
Iowa	Italy
Entire USA	Poland
Wisconsin	Italy
Maine	Turkey
Canada	New Delhi-India
Louisiana	UK
National	China
Maryland, Rhode Island, Pennsylvania	Oregon
Overseas	Puerto Rico
Oregon	Russia
International	New Jersey
Ireland	Rivers, Nigeria
Ethiopia, Addis Ababa	NJ, NY, DE
District Of Columbia	Italy
Greece	& Missouri
Turkey	British Columbia

5.2 Highest Level of Education

Respondents were asked about the highest level of education reached. The majority of respondents indicated completing a graduate degree (45.3%, n = 120) followed by a Bachelor's degree (40.8%, n = 108). The result is that almost 87% (86.1%, n = 228) have a Bachelor's degree or higher. Table 22 and Figure 1 depict this information.

Table 22. Highest Level of Education

What is your highest level of education?		
Answer Options	**Response Percent**	**Response Count**
Less than High School	0.0%	0
High School or Equivalent	1.1%	3
Some College	3.8%	10
Two Years of College/Technical School/Community College	9.1%	24
Bachelor's Degree	40.8%	108
Graduate Degree	45.3%	120
Answered question		**265**

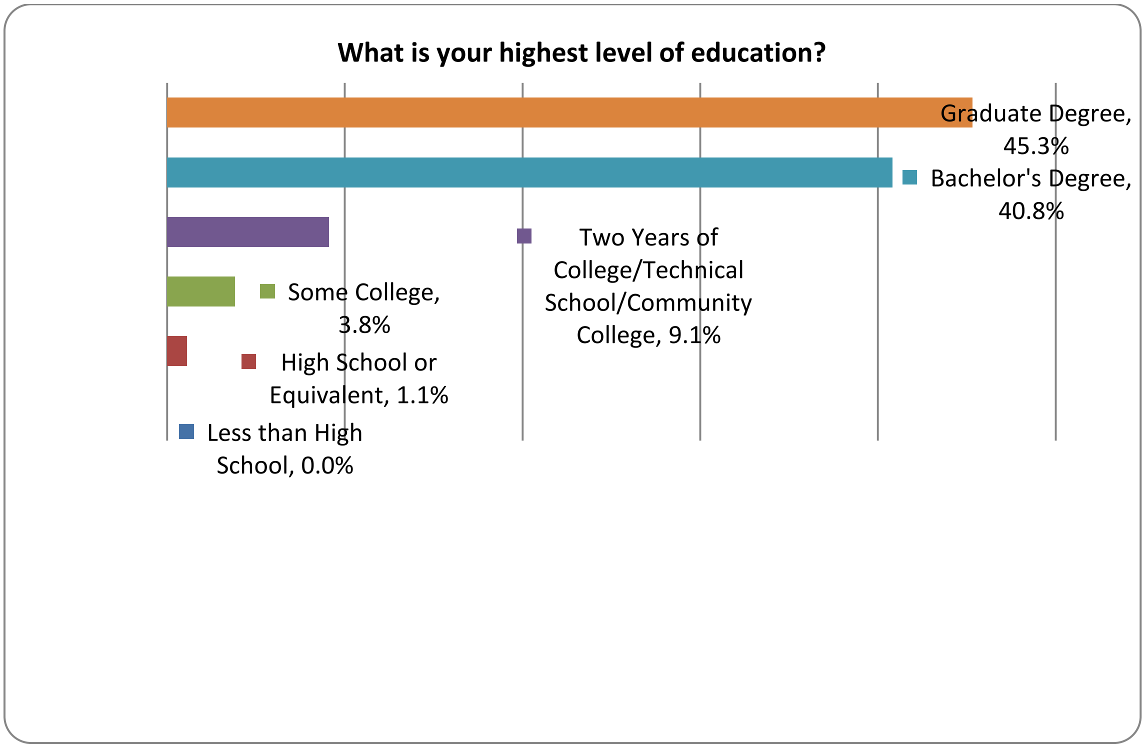

Figure 1. Highest level of education

5.3 Years of Energy Experience

Respondents were asked how many years of experience they have in an energy-related industry (all jobs combined), not necessarily specifically as Energy Auditors. The majority of respondents (38.2%, n = 100) had more than 21 years of experience. Table 23 and Figure 2 depict this information.

Table 23. Years of Energy Experience

How many years of experience do you have in an energy-related industry (all jobs combined)?		
Answer Options	**Response Percent**	**Response Count**
5 years or less	12.2%	32
6–10 years	22.9%	60
11–15 years	12.6%	33
16–20 years	14.1%	37
21 or more years	38.2%	100
Answered question		**262**

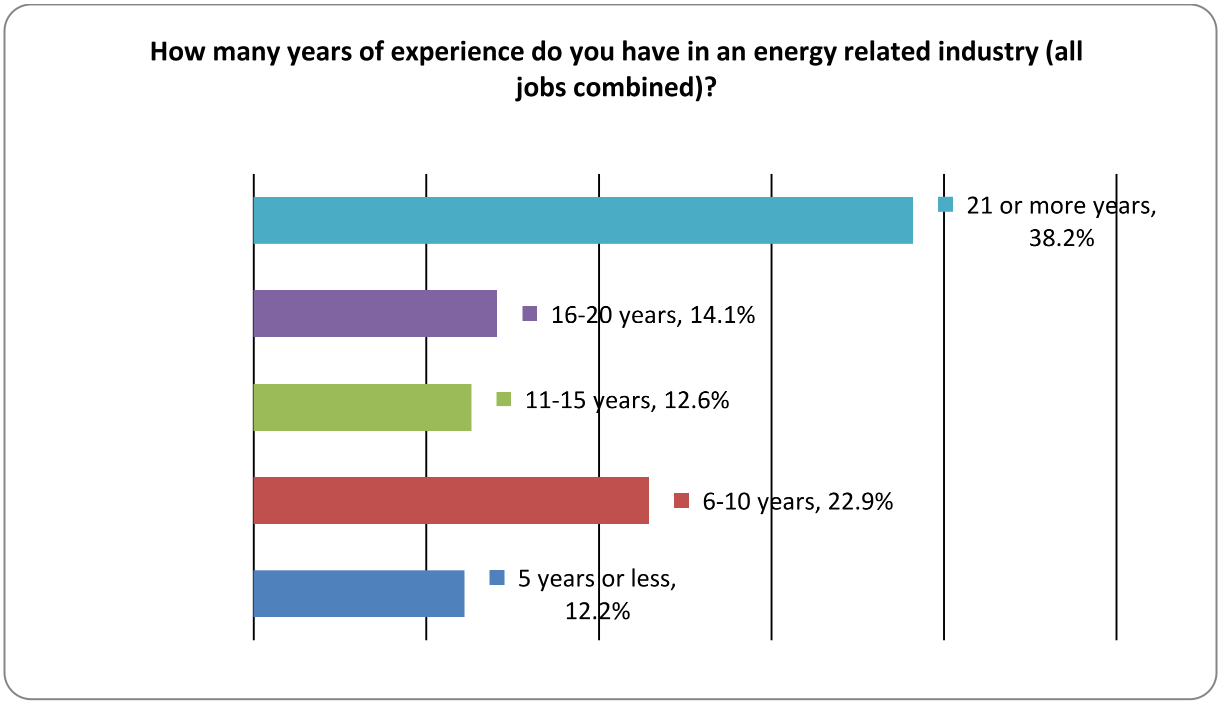

Figure 2. Years of energy experience

5.4 Years of Energy Auditor Experience

Respondents were asked how many years of experience they had specifically as Energy Auditors. Even though the majority had more than 21 years of experience in an energy-related field, 32.8% (n = 87) had fewer than 10 years of experience, and 30.6% (n = 81) had fewer than 5 years of experience. Together this represents more than 65% (68.8%, n = 168) of the respondents having fewer than 10 years of experience as Energy Auditors. The SMEs who reviewed the results of the validation study were asked if this represented a shortcoming in the type of individuals who responded to the survey and if additional respondents with more experience should be targeted. The SMEs felt this was not necessary and believed the responses to be reflective of the industry. They felt that because Energy Auditor as an occupation is a relatively new field, and although a majority had more than 21 years of experience in an energy-related field, the majority with fewer than 10 years of experience reflected the fact that energy professionals had more recently transferred into the field of energy auditing. Table 24 and Figure 3 reflect this information.

Table 24. Years of Experience Specifically as an Energy Auditor

How many years of experience do you have specifically as a Building Energy Auditor?		
Answer Options	**Response Percent**	**Response Count**
None	1.9%	5
5 years or less	30.6%	81
6–10 years	32.8%	87
11–15 years	9.8%	26
16–20 years	11.7%	31
21 or more years	13.2%	35
Answered question		**265**

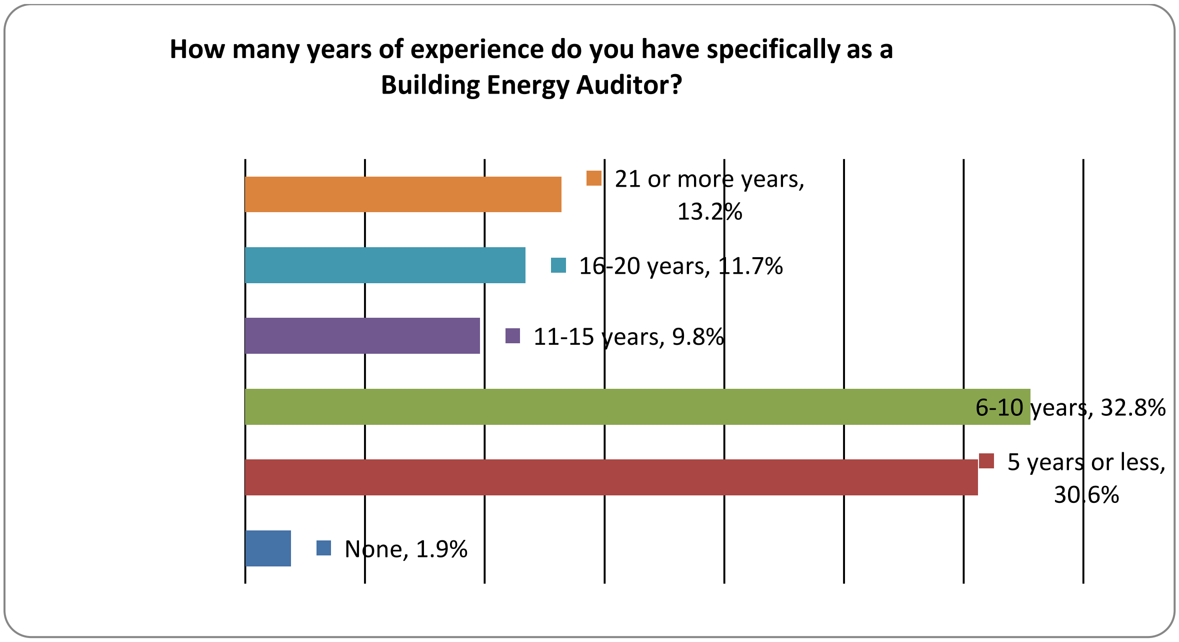

Figure 3. Years of experience specifically as an energy auditor

5.5 Work Sector

Respondents were asked whether they worked in a private or public (government) work sector. A majority (69.37%, n = 183) indicated they worked in a private sector. Table 25 and Figure 4 reflect this information.

Table 25. Sector in Which Respondent Works

In which sector do you currently work?		
Answer Options	**Response Percent**	**Response Count**
Public (government at any level)	30.7%	81
Private	69.3%	183
Answered question		**264**

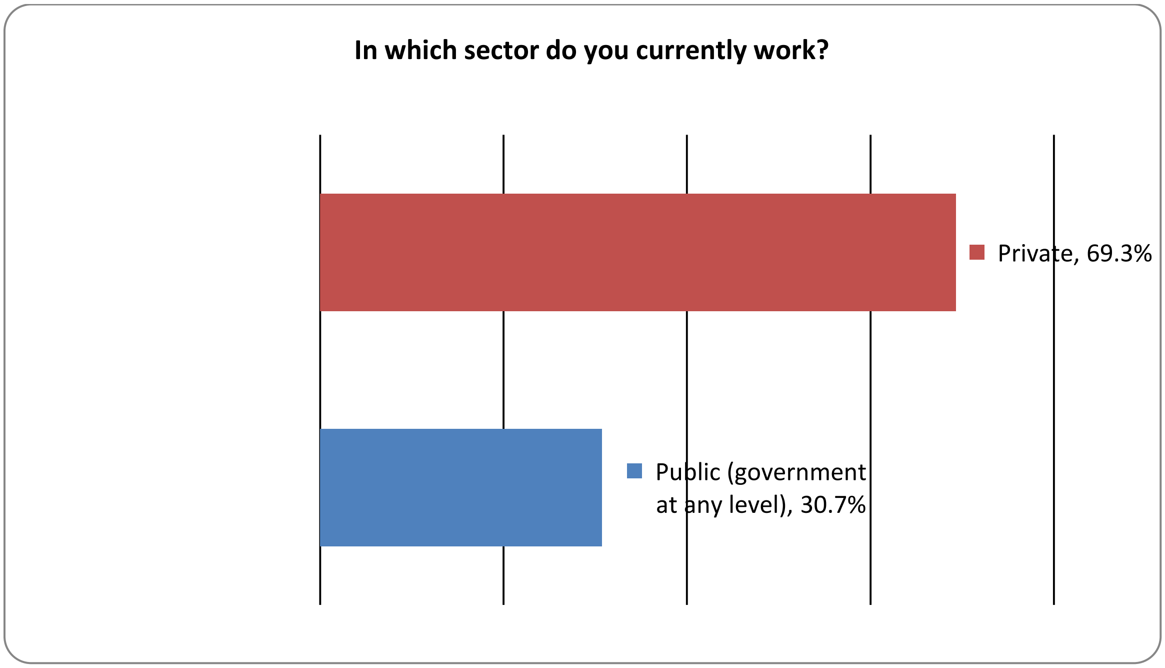

Figure 4. Sector in which respondent works

6 Post-Survey Conference Call and Webinar

Based on this information, Professional Testing, Inc., facilitated a conference call on May 29, 2014, to review and discuss the survey results. The meeting began with a review of the demographic question results to confirm that the sample appeared to be representative of the industry. The attending Energy Auditor SMEs agreed that the group of respondents was representative of the industry. They then reviewed the tasks that were flagged for potential elimination. The resolution of this conference call was to remove none of the competency statements.

6.1 Adequacy of Respondent Demographics

Based on the results of the demographic data, the JTA Committee felt that the respondents were demographically representative and the correct target population was reached.

6.2 Job Task Ratings

Twenty-two tasks were included in the final version of the validation survey. These tasks were grouped based on the seven content domains to be covered by the Energy Auditor examination scheme. The survey used a four-point rating scale for importance of task performance, using the following scale:

1 Not important
2 Somewhat important
3 Important
4 Very Important

In addition to the rating scale for task importance, the survey used a six-point rating scale for the frequency of the task, using the following scale:

1 Never
2 1% to 25% of the time
3 26% to 50% of the time
4 51% to 75% of the time
5 76% to 99% of the time
6 100% of the time

Responses were tabulated and means, standard deviations (SDs), and standard errors of the mean (SEMs) were calculated for the frequency and the importance scales. This information appears in Table 26.

Table 26. Means, SDs, and SEM of Rating Scale Responses

Duties and Tasks	Frequency			Importance		
	Means	SD	SEM	Means	SD	SEM
Communicating with Stakeholders						
Identify the owner's project team	3.18	1.72	0.10	2.18	0.86	0.07
Review the scope and process with the client	3.97	1.44	0.09	2.66	0.60	0.06
Developing the Action Plan						
Conduct pre-audit activities	3.66	1.50	0.09	2.33	0.75	0.07
Generate preliminary list of systems and assemblies to be audited	3.49	1.54	0.09	2.16	0.84	0.07
Determine audit tools and forms	3.49	1.62	0.10	2.12	0.86	0.07
Determine project schedule	3.34	1.55	0.09	1.98	0.84	0.07
Identify safety and access requirements of the facility	3.36	1.65	0.10	2.28	0.86	0.07
Conducting Pre-site Visit Data Collection Activities						
Obtain utility information	4.08	1.38	0.09	2.72	0.56	0.06
Obtain facility data from point of contact	3.74	1.41	0.09	2.40	0.78	0.07
Gather historical weather data	3.10	1.71	0.10	1.93	0.91	0.07
Collecting Data On-site						
Obtain information from facility staff	3.90	1.35	0.09	2.52	0.69	0.06
Obtain information from facility occupants	2.66	1.48	0.09	1.67	0.91	0.07
Assess the building envelope	3.34	1.53	0.09	2.20	0.80	0.07
Assess building systems and components	4.45	1.12	0.08	2.86	0.39	0.05
Analyzing Building Performance Data						
Establish energy and cost baseline	4.16	1.35	0.09	2.71	0.59	0.06
Establish benchmarks	3.66	1.44	0.09	2.24	0.81	0.07
Disaggregate the energy end use breakdown	3.57	1.40	0.09	2.24	0.79	0.07
Identifying Opportunities for Improving Building Performance						
Identify deviations from best practices	3.44	1.52	0.09	2.16	0.84	0.07
Determine energy impact of each measure	4.18	1.21	0.08	2.71	0.55	0.06
Estimate implementation cost	3.77	1.49	0.09	2.57	0.65	0.06
Conduct an economic analysis	3.77	1.46	0.09	2.56	0.67	0.06
Producing the Deliverable						
Write a summary audit report	4.20	1.31	0.09	2.74	0.53	0.06

There were no tasks with less than 2.0 on frequency AND importance; therefore, no tasks were flagged for review during the post-study meeting.

Responses to frequency and importance rankings were combined by doubling the importance and adding the frequency to arrive at a single scale. Table 27 shows the tabulated results.

Table 27. Combined Frequency and Importance Scales

Duties and Tasks	Frequency			Importance			Combined Ratings	Overall Weights
	Means	SD	SEM	Means	SD	SEM		
Communicating with Stakeholders								
Identify the owner's project team	3.18	1.72	0.10	2.18	0.86	0.07	7.55	4.09%
Review the scope and process with the client	3.97	1.44	0.09	2.66	0.60	0.06	9.28	5.03%
Developing the Action Plan								
Conduct pre-audit activities	3.66	1.50	0.09	2.33	0.75	0.07	8.31	4.51%
Generate preliminary list of systems and assemblies to be audited	3.49	1.54	0.09	2.16	0.84	0.07	7.80	4.23%
Determine audit tools and forms	3.49	1.62	0.10	2.12	0.86	0.07	7.73	4.19%
Determine project schedule	3.34	1.55	0.09	1.98	0.84	0.07	7.31	3.96%
Identify safety and access requirements of the facility	3.36	1.65	0.10	2.28	0.86	0.07	7.93	4.30%
Conducting Pre-site Visit Data Collection Activities								
Obtain utility information	4.08	1.38	0.09	2.72	0.56	0.06	9.52	5.16%
Obtain facility data from point of contact	3.74	1.41	0.09	2.40	0.78	0.07	8.55	4.64%
Gather historical weather data	3.10	1.71	0.10	1.93	0.91	0.07	6.97	3.78%
Collecting Data On-site								
Obtain information from facility staff	3.90	1.35	0.09	2.52	0.69	0.06	8.94	4.85%
Obtain information from facility occupants	2.66	1.48	0.09	1.67	0.91	0.07	6.01	3.26%
Assess the building envelope	3.34	1.53	0.09	2.20	0.80	0.07	7.75	4.20%
Assess building systems and components	4.45	1.12	0.08	2.86	0.39	0.05	10.18	5.52%
Analyzing Building Performance Data								
Establish energy and cost baseline	4.16	1.35	0.09	2.71	0.59	0.06	9.57	5.19%
Establish benchmarks	3.66	1.44	0.09	2.24	0.81	0.07	8.13	4.41%
Disaggregate the energy end use breakdown	3.57	1.40	0.09	2.24	0.79	0.07	8.05	4.36%

Duties and Tasks	Frequency			Importance			Combined Ratings	Overall Weights
	Means	SD	SEM	Means	SD	SEM		
Identifying Opportunities for Improving Building Performance								
Identify deviations from best practices	3.44	1.52	0.09	2.16	0.84	0.07	7.77	4.21%
Determine energy impact of each measure	4.18	1.21	0.08	2.71	0.55	0.06	9.61	5.21%
Estimate implementation cost	3.77	1.49	0.09	2.57	0.65	0.06	8.91	4.83%
Conduct an economic analysis	3.77	1.46	0.09	2.56	0.67	0.06	8.89	4.82%
Producing the Deliverable								
Write a summary audit report	4.20	1.31	0.09	2.74	0.53	0.06	9.69	5.25%
							184.41	100.00%

6.3 Tasks or Knowledge Missing

Survey respondents were asked if they felt any tasks or knowledge was missing from the JTA. Appendix B lists all the write-in responses. The JTA Committee reviewed all the comments and determined that the following content should be added to the JTA:

- Information on Energy Modeling. To facilitate this, the SMEs requested that the term *energy calculations* be searched and where it appears in the JTA, the term *energy modeling* be added as a parenthetical example.

6.4 Discussion of Assessment

During the post survey validation conference call, the JTA committee discussed the assessment associated with the JTA. It was determined that a multiple choice examination would be sufficient to measure the knowledge. The JTA committee was presented sample surveys at the 100 item, 120 item and 150 item levels. Each content domain and task area was reviewed for content depth and breadth at each of the various exam length levels with discussion regarding what length examination would be sufficient to cover the content. The committee felt that 100 test items would be needed to sufficient cover the depth and breadth of the content so a 100 item examination length was selected.

7 Conclusions and Next Steps

The JTA is the first step in the test development process; it is the primary source of evidence for the examination's validity. The final DACUM JTA is now validated and may be used by training organizations to develop training programs and by a certification body or scheme committee to develop a certification scheme. The final DACUM JTA for Energy Auditors appears in Table 19.

Appendix A: Energy Auditor Validation Study Survey

Commercial Workforce Credentialing Council Job Task Analysis Validation

Welcome!

The National Institute of Building Sciences Commercial Workforce Credentialing Council and industry stakeholders have a project to improve the quality and consistency of commercial buildings workforce training and certification programs for four key energy-related jobs.

In support of this project, the National Institute of Building Sciences (NIBS), and Professional Testing, Inc. are seeking members of the commercial buildings industry to participate in a nationwide research study validating job task analyses (JTAs) of four key energy-related jobs in the commercial buildings sector. The JTA is a procedure for analyzing the tasks performed by individuals in a specific job, as well as the knowledge, skills, and abilities necessary to perform those tasks. JTAs are critical elements of quality training programs and professional certifications.

Current industry practitioners whose work falls into one or more of the following job categories may complete a validation study by **April 25, 2014**. Each energy-related job area survey is nine pages. For each survey you will rate the frequency and importance of the work activities associated with each area of responsibility. Participation should take approximately 30–45 minutes and individuals may complete more than one validation study, if applicable. When determining applicability, practitioners should focus on the details of the job descriptions rather than on the job title, as job titles frequently vary from one employer to another.

You do not have to respond to all surveys however we ask you to please finish any survey you start.

If you do not have time to complete the survey in one sitting, you can stop and complete the survey later (provided you use the same computer and have cookies enabled on that computer). The survey will resume where you stopped. If you do not have cookies enabled, the survey will start over from the beginning again.

Your responses will be kept confidential, and we appreciate your assistance. If you have any difficulty responding to this survey, please contact NIBS at dsmith@nibs.org.

On the next page you will be given the opportunity to select the energy-related job survey you are interested in responding to.

Commercial Workforce Credentialing Council Job Task Analysis Validation

*** Following is a description of the remaining surveys you may respond to. Please review the job descriptions and select the survey for which you feel most qualified. Please select the survey for which you wish to respond:**

- ○ Building Energy Auditor - Energy solutions professional who assesses building systems and site conditions; analyzes and evaluates equipment and energy usage; and recommends strategies to optimize building resource utilization.
- ○ Building Operations Professional - Manages the maintenance and operation of building systems and installed equipment, and performs general maintenance to maintain the building's operability, optimize building performance, and ensure the comfort, productivity and safety of the building occupants.
- ○ Building Commissioning Professional - Leads, plans, coordinates and manages a commissioning team to implement commissioning processes in new and existing buildings.

Commercial Workforce Credentialing Council Job Task Analysis Validation

Please answer the following background questions. Your responses will be kept confidential and this information will only be used for statistical purposes.

In which state do you primarily work?

Other (please specify)

What is your highest level of education?

- Less than High School
- High School or Equivalent
- Some College
- Two Years of College/Technical School/Community College
- Bachelor's Degree
- Graduate Degree

How many years of experience do you have in an energy related industry (all jobs combined)?

- 5 years or less
- 6-10 years
- 11-15 years
- 16-20 years
- 21 or more years

How many years of experience do you have specifically as a Building Energy Auditor?

- none
- 5 years or less
- 6-10 years
- 11-15 years
- 16-20 years
- 21 or more years

In which sector do you currently work?

- Public (government at any level)
- Private

Commercial Workforce Credentialing Council Job Task Analysis Validation

Instruction Page

In the following pages, you will be asked to think about tasks that a Building Energy Auditor does and to indicate the frequency with which a Building Energy Auditor performs each task on a job. Then, considering the same task statement, you will be asked to indicate how important it is that a Building Energy Auditor knows how to do each of these tasks. To respond click the drop down menu and select your response.

Commercial Workforce Credentialing Council Job Task Analysis Validation

When a Building Energy Auditor is Communicating with Stakeholders, please indicate how frequently this task is performed on the job and how important this task is to a Building Energy Auditor.

	Frequency - How often is this task performed on the job?	Importance - How important is this task to the overall successful performance of a Building Energy Auditor?
Identify the owner's project team		
Review the scope and process with the client		

When a Building Energy Auditor is Developing the Action Plan, please indicate how frequently this task is performed on the job and how important this task is to a Building Energy Auditor.

	Frequency - How often is this task performed on the job?	Importance - How important is this task to the overall successful performance of a Building Energy Auditor?
Conduct pre-audit activities		
Generate preliminary list of systems and assemblies to be audited		
Determine audit tools and forms		
Determine project schedule		
Identify safety and access requirements of the facility		

When a Building Energy Auditor is Conducting Pre-site Visit Data Collection Activities, please indicate how frequently this task is performed on the job and how important this task is to a Building Energy Auditor.

	Frequency - How often is this task performed on the job?	Importance - How important is this task to the overall successful performance of a Building Energy Auditor?
Obtain utility information		
Obtain facility data from point of contact		
Gather historical weather data		

Commercial Workforce Credentialing Council Job Task Analysis Validation

When a Building Energy Auditor is Collecting Data On-site, please indicate how frequently this task is performed on the job and how important this task is to a Building Energy Auditor.

	Frequency - How often is this task performed on the job?	Importance - How important is this task to the overall successful performance of a Building Energy Auditor?
Obtain information from facility staff		
Obtain information from facility occupants		
Assess the building envelope		
Assess building systems and components		

When a Building Energy Auditor is Analyzing Building Performance Data, please indicate how frequently this task is performed on the job and how important this task is to a Building Energy Auditor.

	Frequency - How often is this task performed on the job?	Importance - How important is this task to the overall successful performance of a Building Energy Auditor?
Establish energy and cost baseline		
Establish benchmarks		
Disaggregate the energy end use breakdown		

When a Building Energy Auditor is Identifying Opportunities for Improving Building Performance, please indicate how frequently this task is performed on the job and how important this task is to a Building Energy Auditor.

	Frequency - How often is this task performed on the job?	Importance - How important is this task to the overall successful performance of a Building Energy Auditor?
Identify deviations from best practices		
Determine energy impact of each measure		
Estimate implementation cost		
Conduct an economic analysis		

When a Building Energy Auditor is Producing the Deliverable, please indicate how frequently this task is performed on the job and how important this task is to a Building Energy Auditor.

	Frequency - How often is this task performed on the job?	Importance - How important is this task to the overall successful performance of a Building Energy Auditor?
Write a summary audit report		

Commercial Workforce Credentialing Council Job Task Analysis Validation

Review the specialized knowledge below and indicate the depth of knowledge that is required of a Building Energy Auditor.

	No knowledge needed	Some knowledge needed	Moderate knowledge needed	Extensive knowledge needed
Air compressors	◯	◯	◯	◯
Audit processes and tasks	◯	◯	◯	◯
Basic business knowledge	◯	◯	◯	◯
Basic statistics	◯	◯	◯	◯
Benchmarking resources	◯	◯	◯	◯
Building automation control systems and programming	◯	◯	◯	◯
Building HVACR systems	◯	◯	◯	◯
Building interior and exterior lighting fixtures and controls	◯	◯	◯	◯
Building physics	◯	◯	◯	◯
Building pressurization	◯	◯	◯	◯
Building sciences	◯	◯	◯	◯
Building systems, engineering concepts and principles	◯	◯	◯	◯
Components of building and process systems and assemblies	◯	◯	◯	◯
Consultant and client roles	◯	◯	◯	◯
Data collection protocols	◯	◯	◯	◯
District energy	◯	◯	◯	◯
Electrical power systems	◯	◯	◯	◯
Elevation orientations	◯	◯	◯	◯
Energy efficiency measures (EEM) most frequently and commonly identified	◯	◯	◯	◯
Energy supply mechanisms (deregulation, etc.)	◯	◯	◯	◯
Energy units of measure	◯	◯	◯	◯
Engineering economics	◯	◯	◯	◯
Financial analysis methods	◯	◯	◯	◯
Financial terminology	◯	◯	◯	◯
General building construction materials	◯	◯	◯	◯
Greenhouse gas calculations	◯	◯	◯	◯

Commercial Workforce Credentialing Council Job Task Analysis Validation

Heat transfer	◌	◌	◌	◌
Heating and cooling degree days and balance point temperature	◌	◌	◌	◌
Historic building practices	◌	◌	◌	◌
IEQ	◌	◌	◌	◌
Impact of age of building on building systems	◌	◌	◌	◌
Industry accepted standards, codes and guidelines	◌	◌	◌	◌
Industry equipment	◌	◌	◌	◌
Industry terminology	◌	◌	◌	◌
Low temperature refrigeration systems	◌	◌	◌	◌
M&V	◌	◌	◌	◌
Maintenance procedures and roles	◌	◌	◌	◌
Measuring equipment (current transformers, data loggers, etc.)	◌	◌	◌	◌
Methods of general construction and construction trades	◌	◌	◌	◌
Minimum required time period of utility data	◌	◌	◌	◌
Onsite energy generation (CHP, PV, wind, thermal, etc.)	◌	◌	◌	◌
Operations	◌	◌	◌	◌
Potential hazards associated with various building systems	◌	◌	◌	◌
Potential hazards associated with various pieces of equipment	◌	◌	◌	◌
Process systems and controls	◌	◌	◌	◌
Rebates and incentives	◌	◌	◌	◌
Safety practices	◌	◌	◌	◌
Sampling strategies	◌	◌	◌	◌
Service hot water and control systems	◌	◌	◌	◌
Solar mapping	◌	◌	◌	◌
Systems interactions	◌	◌	◌	◌

Thermal camera operations	◯	◯	◯	◯
Types of audits (level 1, 2, or 3, etc.)	◯	◯	◯	◯
Typical energy analysis methodologies	◯	◯	◯	◯
Typical energy usage by building type	◯	◯	◯	◯
Typical facility organizational structures	◯	◯	◯	◯
Typical percentage of end usage by occupancy type	◯	◯	◯	◯
Understand available data types for weather (bin data, hourly data, TMY, etc.)	◯	◯	◯	◯
Understanding of energy suppliers and types	◯	◯	◯	◯
Understanding of engineering practices	◯	◯	◯	◯
Understanding of industry best practices for various building systems	◯	◯	◯	◯
Understanding of utility bill information	◯	◯	◯	◯
Understanding of what an energy audit is	◯	◯	◯	◯
Utility rate schedules	◯	◯	◯	◯
Water distribution and control systems	◯	◯	◯	◯
When a building needs to be "tuned up" versus new installations	◯	◯	◯	◯
Window types	◯	◯	◯	◯

Commercial Workforce Credentialing Council Job Task Analysis Validation

Are there any job related tasks that are missing from this survey?

No

Yes

If yes, what?

Is there any knowledge that we did not include in this survey that should have been included?

No

Yes

If yes, what?

Commercial Workforce Credentialing Council Job Task Analysis Validation

If a certification examination were to be developed based on this information, please enter the percentage of the exam that should be devoted to each of the content areas listed below.

(Note: Your responses should add up to 100.)

Communicating with Stakeholders	
Developing the Action Plan	
Conducting Pre-Site Visit Data Collection Activities	
Collecting Data On-Site	
Analyzing Building Performance Data	
Identifying Opportunities for Improving Building Performance	
Producing the Deliverable	

Commercial Workforce Credentialing Council Job Task Analysis Validation

* **Do you wish to respond to another survey?**

- Yes
- No

Appendix B: List of Write-In Comments

- Be able to collaborate effectively with subcontractors in validating solution costs 2. Execute continuous improvement analysis on customer's utility consumption and utility spend in-order to continually reduce customer's building systems operating expenses
- Organizing and leading audit teams.
- Estimating level of effort appropriate versus budget and risk (i.e. Level 1, 2 or 3 audit).
- Ability to verify Equipment "Right-sizing" by performing calculations (HVAC loads, Pump head and fan Sp calcs, etc.) Ability to verify and match equipment size in place Vs Actual building occupancy and operation.
- Analysis of steam systems
- Analysis of surrounding landscape.
- Analysis of various building systems, especially HVAC, electrical, and piping systems. For HVAC must understand sequence of operations.
- Appropriate level of engineering calculations to support project
- Assess behavior modification applicability.
- Audit report composition. Audit report review. Use of energy audit equipment (as opposed to "knowing about" which is present).
- Blower door test and infrared scan of thermal shell
- Building Automation System Capability Assessment
- Building systems contractor
- Calculation of adjustments to benchmark data to account for changes in building parameters (examples: sq-footage, load, mechanical changes and weather) between the benchmark year and the current comparison year.
- Client Interview technique. Also, My answers were based on 80% of my work being SF and 20% Multi-Fam, two somewhat separate skill sets, smushed together.
- Collecting data for energy wasted by computer/electronic related loads; human factors; poor management decisions.
- Commissioning of systems versus retro-commissioning and their importance.
- Communication and interaction with people at various levels
- communication skills, multi-tasking, ability to do electrical measurements
- Continuing education on improvements in energy efficient products and their application
- Developing and using energy calculation tools to model energy usage for systems that do not currently have tools to accurately model their usage.
- Documenting the process, reevaluating the appropriateness of the energy analysis methodology
- Energy conversion factors for unit of gas, oil, coal, steam etc. consumed. Efficiencies of energy using equipment. Measuring air, water, steam flow
- Energy Modeling
- Energy modeling activities. Sometimes we use simplistic energy models to estimate energy savings from energy efficiency measures that have multiple system interactions or complex control sequences.
- Energy modeling and calibration of energy models
- Energy modeling, Energy Model Calibration
- Familiarity with building analysis software. Sufficient knowledge to make sure life cycle costs include all related expenses, including salary of the long term maintenance staff.
- Field Verification and Diagnostic testing; concepts, methods and tools, application

- Follow up, Quality Control during the process and delivery of the job. The worst concept develop over the years in construction business is TIME IS MONEY. Consumers will pay in bad way the speed the crews have to work based on schedules based on production not as Quality and responsible practices.
- Fuel usage by the facility (propane, diesel, natural gas, fuel oil #6, fuel oil #2). Occupancy rate (permanent and/or in transition) Storage spaces and type of materials to be storage. Hazardous materials disposition Safety and Security Regulations
- I am working with PNNL on the Commercial Building Score, and our assessors do a "basic" commercial audit Level 1 for the City of Austin's ECAD ordinance. This is a Portfolio Manager audit. My people need basic info, not engineering type info.
- I have may missed these points, but here they are just in case: Need to request for as-builts or design operation documents for systems. May have to contact manufacturer, installer or engineer Check EMS and EIS systems for system load profile and operations characteristics Once EEMs have been identified, conduct site testings or review trend data to supplement energy savings calculations models As part of a deliverable, be able to communicate the strategy for achieving savings, and how they were estimated along with the possible operations and financial risks As part of a deliverable, submit a savings tracking plan As part of deliverable, a summarized report is usually insufficient and must include calculations summary, equipment system cut sheets and site photos. Also include an in-person presentation.
- Implied in questionnaire but importance of performing cross-checks. Modeling using software or bin data or whatever can be useful but can also result in savings overstating what is possible. Spreadsheet tools have similar issues. Balancing the use of both along with the research aspects to validate savings potential is important so here are some thoughts: 1. Modeling tools and resources 2. Spreadsheet analysis for potential savings 3. Researching publicly available studies regarding potential for savings. 4. Research to identify manufacturer and other claims that are snake oil.
- Initial assessment to determine if the building is in need of an audit or a remodel from the bottom up, instead of trying to overlay an energy management strategy. The saying goes, if you put lipstick on a pig it's still a pig! I have seen too many times businesses trying to "sale" something rather than addressing the buildings needs first to lower the overall consumption of energy before estimating an energy generation for a sick building.
- Just in general your survey was difficult for example asking about experience with compressed air systems in an industrial building is extremely important but in a commercial building not at all so. Similarly, there were so many questions/topics that are vital to industrial but not so commercial. This type of "confusion" pervades the questionnaire, making it essentially useless in "standardizing" qualifications for commercial building energy auditor.
- Knowing the expected useful life of various types of equipment; determination of peak demand savings; calculation strategies to determine energy savings
- Knowledge and ability to use modeling software
- Knowledge of lighting systems and latest technology. Knowledge of behavior issues and how this translates to energy savings. Knowledge of plug load and other devices. Running down data is very hard in most cases. Folks just do not keep up with utility bills and equipment maintenance.
- Made mention of in first questions, the importance of interviews with building occupants.
- Many times building auditing may write a contract scope to accomplish phased levels of performance. Contract or scope writing with legal authority and understanding of wishes and wants versus solid engineering for performance need to be delineated. Structuring a contract for performance needs to be written clearly for measurable results and be able to convey levels

of expectation to the owner/user. If performance is linked to incentives then that rate or pay agreement needs to be clear.

- Modeling of existing buildings (Trace, eQuest)
- Most often, the Energy Auditor is also the "Point of Contact" to assist the Client to implement a project based on the findings and within the parameters of the scope the client set. So Project Management is often a related task that needs to be done well in order to realize a successful result.
- Occupancy related overrides or ignorance of the costs associated with energy ignorance. Monitoring of individual areas for success through training of occupants or supervisors.
- Performing a building simulation. When it comes to envelope and HVAC, how do you expect to provide projected savings without a simulation? All the job related tasks covered in the Certified Energy Manager curriculum! Did you by chance think to use a CEM to write this survey? Pre-Site visit? Action Plan? That sounds typical of a government agency! "Well let's do a pre-site visit and spend time and money talking about how we'll do this job. Then we can develop an action plan, and let's make sure to get someone to sponsor dinner. Let's have a meeting to discuss anything we need to cover in our pre-site visit too!" Get busy with it! Go to the job site, and get started! You start with recognizing any safety issues, and then you get busy with the "AUDIT" Look up the meaning of the word! It's an accounting! An accounting of all energy use. While you're having meeting, my company will have already talked to the owner and his people, collected the data we need, and made any additional measurements, finished the analysis and given the owner a report outlining where he can save energy, how many dollars it will save, and how much it will cost! GET REAL!
- Presentation and explanation of findings to building owners/management
- Pressure testing
- Probably, but I am not a consultant for this activity.
- Pumps, Duct Work, Roofing Systems, Make-Up Air, Lighting Systems, VFD, Waist Stream, Elevators. Exposed HVAC Sheet Metal Duct Work Curb Adapters.
- Reading & understanding equipment data tags Matching calculated kWh and BTUs of all equipment to actual billing Pollution reduction for implementing recommended energy saving technologies or procedures
- report writing
- Report writing skills.
- The list is very complete however we use teams to complete these tasks and not every member needs expertise in every area. For example and engineer may understand the details of codes and standards while a technician may have more experience in using data loggers.
- Total Cost of Ownership OPEX to CAPEX Value Proposition Financing Options available Educating Customers
- True cost estimating for implementation of ECMs. We always use a Certified Professional Estimator (CPE) for our projects, utilizing the MEANS cost data guides. Without that, validating the paybacks is very difficult. This is where most audits fall flat when the implementation phase is executed.
- Types of audit tools available
- Understanding a customer's acceptable criteria for an energy project.
- Understanding appropriate level of calculation required for project type. Different types of calculations Knowledge of hourly whole building simulation

- Understanding of utility incentive programs my job for 18 years has been to conduct due diligence reviews of commercial building, industrial, and agricultural energy efficiency projects for utility DSM programs.
- Understanding the maintenance staff concerns and requirements. Understanding of the age of equipment installations and what this means for efficiency and cost of operations. System troubleshooting
- Unless accounted for in another category, performing energy savings calculations via spreadsheets and/or energy models is a required job task.
- Use of energy simulation tools.
- Use of ultrasonic monitoring equipment to find and locate pneumatic system leaks; even a small leak on a system can get really expensive. Extensive knowledge of building mechanical systems and maintenance program audits- I have seen several glaring cases of clients saying they have a great maintenance program, only to find their staff jury rigs actuators and dampers in ways that totally defeats their purpose and causes significant cost increases.
- using Portfolio Manager; speaking to the customer; presentation
- Walk-throughs or communication with decision makers
- Writing clear and concise reports than can be easily understood by different people with different skill levels and familiarity with building systems and financial analysis, etc. Data collection and building survey with photos. Life Cycle Costing and Payback Calculations
- 1. Experience and knowledge of conducting life cycle cost analysis. 2. Experience and knowledge of system repair costs. 3. Experience and knowledge of using HVAC energy analysis software
- Advanced HVAC Control strategies Troubleshooting Commissioning Reliability Flexibility Considerations Rebate and Grant programs Financing Options Project Management Scheduling
- Albido effect on lighting. Urban Heat Island Effect. Shading of the facility by trees. Wind control by trees.
- As an Energy Manager for almost 20 years for local Universities and Hospitals I'm very interested in the direction this new certification program is going. I can't speak nationally but I have extensive experience in the North West region, the AEE's C.E.M program requirements and certifications are held in high regard and are the standard for Energy Professionals. I would hope that your team looks to the AEE and reviews the programs they have had in place for over 30 years. The Minnesota group of C.E.M.'s meet on a regular basis and are the best and brightest in the field, I hope there's a grandfathering process for current energy professionals for any new certifications being rolled out.
- As improvements in technology increases, there is an extensive void in the abilities of the folks maintaining these new systems. This is best seen at the local level (munis, counties and K12's) where staffs are under staffed and lack the knowledge of the systems being installed.
- ASHRAE Standards
- Basic knowledge of internet; basic knowledge of technologies using an android device, typing skills, oral communications. ROI knowledge.
- Building code requirements.
- Building energy modeling
- Building Performance Rating Systems
- CEM certification needs to a job requirement. It differentiates and identifies a true professional in this growing field. The examination process is rigorous and the AEE association is invaluable.
- Could be something related to simplified building dynamic energy use analysis tools?
- Defining what type of audit (Level 1, 2, or 3) for each question. Most answered centered around 1 or 2.

- Detailed knowledge of industry accepted energy calculations is required to determine equipment energy use and savings. Understanding of client reporting requirements (i.e. NYC Local Law 87, NYSERDA, etc.)
- Discussing issues with the facility operator in such a way that they do not feel threatened by your presence. Lots of times auditors are viewed as people trying to determine "what is wrong" in a facility. It's very important to be viewed as an agent of change that can help the facilities group, rather than someone who is going to create more work/trouble for them.
- Do you know were the cafeteria is?
- Effect of surrounding buildings and adjacent landscape on the performance of the building
- Energy modeling activities. Sometimes we use simplistic energy models to estimate energy savings from energy efficiency measures that have multiple system interactions or complex control sequences.
- Energy modeling, Energy Model Calibration
- Envelope moisture issues (maybe included as building physics)
- Ethics.
- Fundamental engineering calculations in order to develop and use energy calculation tools to model energy usage for systems that do not currently have tools to accurately model their usage. Engineering calculation software (Excel, Matlab, etc.). Validate model results and tuning to using benchmarks, utility bills, typical usages, etc.
- Highly effective communication skills (written and verbal) in order to persuade the client to implement cost effective improvements. Otherwise the exercise was a waist of time and a failure despite all of the other valued skills.
- How building automation systems function. Building scheduling by occupancy type. Building control system optimum start. Best practices for central chilled water (chiller) plant operation and control. Best practices for boiler plant operation and control. Best practices for air system operation and control. Best practices for lighting levels and controls.
- HVAC
- HVAC design, Electrical design, Piping design need to be able to look at various systems and know what design changes can be made and at what cost. Must be able to do full energy analysis of modifications using building modeling or BIN energy analysis.
- I think there needs to be a little
- Impacts of energy codes/ISP on baseline development for measure savings under utility DSM programs.
- In my own energy auditing practices, I used the Energy Star Building Upgrade Manual as well as information about ASHRAE Level 1, 2, and 3 studies. I think also how to use the JTA for Commercial Building Energy Auditors (another NREL program I was involved in) for not just doing audits, but how this can be leveraged in selecting suppliers to accomplish the physical upgrade after the audit is complete. There is a huge book of knowledge available, such as the International Facility Management Association's recently upgraded BEX program for benchmarking.
- IPMVP, standards, codes and legislative decisions.
- Just the practical evaluation of a building instead a sales driven approach. I understand that businesses need to make a profit to stay in business, but I believe that the ethical part of surveying a building needs to be address rather than trying to sale a bunch of bells and whistles that end up in a lawsuit.
- Know what websites (governmental, utility, and vendor) provide information on determining and/or calculating equipment power requirement.

- Knowing to interact with and engage top management whenever possible to achieve energy conservation. WELL, THE LAST QUESTION LACKS AT LEAST ONE ESSENTIAL ITEM: ANALYZING ENERGY CONSUMPTION AND CONSERVATION ON A SYSTEM LEVEL (E.G., HVAC, LIGHTING). UNLESS THE REPORTS PRODUCED BY THE BUILDING ENERGY AUDITOR ARE REFLECTING SUCH ANALYSIS, THE RESULTS MAY BE NOTHING MORE THAN FLUFF.
- Knowledge and ability to use modeling software
- Knowledge related to types of utilities and their relationship to Locale of facility. What is the relationship between the Energy provider and the customer? What are the financial resources available to the owner to implement the audited ECM.
- Math Life Cycle Costing and Payback Calculations Pricing for equipment and labor, or knowledge of where to find that information for new equipment
- Maybe something about where you are, the work they are doing, and what software they use?
- Mentioned above Small-Mid market space, industrial and commercial customers do not have dedicated staff. You become their energy advisor. Different skills necessary to educate customers and guide them towards a financial value proposition.
- moderate understanding of statistics as it relates to data and usage trend analysis, correlation (example: between benchmark and current sample), deviation from benchmark, etc)
- Motor knowledge, fan laws, pump laws, everything that is covered by a mechanical or electrical engineering degree! Everything that is currently covered by the Certified Energy Manager curriculum (CEM). Why the hell are you reinventing the wheel? If you want to call it something different, then just rename it. Statistics? Seriously? You go on to each site, and you account for every piece of energy using equipment, and how it's being used! That's why it's called an AUDIT! You then apply your ENGINEERING knowledge to how you can reduce the energy use of each item, and compare that savings to the cost of improvement using Time Value of Money. This isn't exactly rocket science folks! It doesn't matter what statistics show. Most companies, or buildings, have there own personality. When you start bunching things together and just throwing what usually works, you can miss key items that can be big savers. Using statistics is like pre-judging, or prejudice. Keep your statisticians working with the spin doctors, and leave the energy audits to the scientists called Engineers!
- OSHA Regulations Environmental Compliance Issues (Air, Water, Soil) ISO Regulations
- Project management skillsets as a family are critical. Several of the lines hint at it but PM as a family is critical. Some form of formal training in energy auditing is critical. I was formally trained by the DOE's IAC program over more than 3 years. Some students are now receiving it in college. However, most of the time it's still "on the job." Big gaps happen in knowledge if an individual has concentrated on design engineering and tries to switch from that to energy auditing energy management without training mentorship.
- Quantified tests for baseline data before retrofit
- Salesmanship packaging of the information in a way to get your message across.
- Same
- see above
- Spreadsheets & databases
- Steam system engineering.
- Steam system knowledge
- supporting new buildings/ extensive retrofit when existing information is not relevent
- test equipment what tool to use
- The strengths and weaknesses of sampling activities minimization of sampling tactics produces maximization of energy audit findings' effectiveness.

- Thermodynamic Fundamentals Regulation acknowledgment
- These seem to be missing from the list: Knowledge in energy modeling software tools and their shortcomings Public speaking and persuasion skills Ability to write new Standard Operating Procedure for O&M staff, or conduct training session to ensure persistence of savings Must have advanced knowledge of spreadsheet software tool
- Thorough knowledge of Hydronic systems, such as parallel pumping, hydronic balancing, etc.
- Types and use of audit tools available
- understanding of electrical distribution systems
- Understanding of lighting design. i.e., providing adequate lighting for task while achieving energy efficiencies and using right controls.
- Understanding of recommissioning.
- Yes, good to promote software skills, TREAT, HERS analysis, etc.
- Yes, same as above, in reference to commissioning. 1. Experience and knowledge of conducting life cycle cost analysis. 2. Experience and knowledge of system repair costs. 3. Experience and knowledge of using HVAC energy analysis software

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