NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Multifamily Energy Auditor Job/Task Analysis and Report

September 2013

Corina M. Owens, Ph.D.
Professional Testing Inc.
Orlando, Florida

NREL Technical Monitor: Christina Larney

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Subcontract Report
NREL/SR-7A40-60447
September 2013

Contract No. DE-AC36-08GO28308

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Project Overview

The U.S. Department of Energy (DOE) Weatherization Assistance Program (WAP) and the National Renewable Energy Laboratory (NREL) developed the Guidelines for Home Energy Professionals (Guidelines) project to support and promote high-quality energy upgrade work within the WAP.

The development of job/task analyses (JTAs) is one of three components of the Guidelines project, and it will allow industry to leverage these components to develop training resources, quality assurance protocols, accredited training programs, and professional certifications. The development of these foundational materials for the WAP, and for the home performance industry, will facilitate a growing, skilled workforce for home energy upgrades that is able to meet the increasing demand for energy upgrade work while maintaining quality assurance for homeowners and employers.

NREL secured the services of Professional Testing Inc. to develop JTAs and specifically to identify and catalog all of the tasks performed by individuals in each of the multifamily specific job categories listed below, as well as the knowledge, skills, and abilities (KSAs) needed to perform the identified tasks.

- Multifamily Energy Auditor
- Multifamily Building Operator
- Multifamily Retrofit Project Manager
- Multifamily Quality Control Inspector.

This report describes the JTA development process, provides a summary of the JTA validation study and an analysis of the study data, and contains a content outline and "developing a curriculum" DACUM chart for multifamily energy auditors.

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Introduction

Job/task analysis (JTA) is a procedure for analyzing the tasks performed by individuals in an occupation, as well as the knowledge, skills, and abilities (KSAs) necessary to perform those tasks. Specifically, JTAs can be defined as "any systematic procedure for collecting and analyzing job-related information to meet a particular purpose" (Raymond, 2001, p. 372).

The use of JTAs (also known as job analysis, task analysis, practice analysis, or role delineation) to define the content domain is a critical component in establishing the content validity of a training or examination program. Content validity refers to the extent to which the domain outline of the training or examination program overlaps with the important components (i.e., KSAs) of a job.

A well-defined JTA includes participation by a representative group of subject matter experts (SMEs) who reflect the diversity within the job. Diversity refers to regional or job context factors and to SME factors such as years of experience, and education. Demonstration of content validity is accomplished through the practical experience of industry professionals and SMEs. The process is enhanced by conducting a validation study that allows for the inclusion of larger numbers of industry professionals and SMEs.

JTAs can be used for multiple purposes including, but not limited to, job description, job classification, job evaluation, performance appraisal, training, worker mobility, workforce planning, efficiency, safety, and legal and quasi-legal requirements (Brannick et al. 2007). Job analyses are traditionally used by secondary and post-secondary educators, business or industry trainers, government or military trainers, and test developers. Although there are multiple methods for conducting JTAs, this project used the "developing a curriculum" (DACUM) method.

DACUM is an occupational analysis led by a trained facilitator, in which practitioners and SMEs 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. Modified small-group brainstorming techniques are used to obtain the collective expertise and consensus of the group. DACUM has proven to be a very effective method of quickly determining, at relatively low cost, the competencies or tasks that must be performed by persons employed in a given job or occupational area.

The DACUM chart that results from the DACUM analysis is a detailed portrayal of the skills and competencies involved in the occupation being studied. The DACUM analysis can be used as a basis for various aspects of an education/training or certification program including curriculum development, student learning, training needs assessments, worker performance evaluations, and competency test development.

Process for Selecting Subject Matter Experts

Professional Testing, Inc. helped establish the criteria for selecting the panel of SMEs and practitioners. Active practitioners and SMEs interested in participating in the study were invited to submit their credentials through a publically announced online submission process. To be

eligible for participation in the JTA workshop, applicants had to be current, active practitioners and available to attend the entire workshop session in person.

A total of 136 applications were received for participation in the multifamily JTA workshops and of these, 126 were qualified as current practitioners in the multifamily energy upgrade industry. When applying, applicants provided rankings as to which job designation they preferred most and each applicant was considered for up to two JTA workshops. A total of 79 applicants were considered for the multifamily energy auditor JTA workshop.

To create a representative panel of participants, Professional Testing, Inc. used specific ranking criteria including:

- Geographic (including regional/climatic) 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.

Twelve applicants meeting the above criteria were selected to create the multifamily energy auditor SME panel.

A copy of the opportunity announcement that solicited applications for the multifamily JTA workshops is included in Appendix A.

Methods

Overview of Job Analysis Process

A job analysis or practice analysis is a foundational requirement of any valid credentialing program, and it helps define the core knowledge areas, critical work functions, and/or skills that are common across a representative sampling of current practitioners or incumbent workers. Empirical results from the job analysis provide examinees and the public the basis of a valid, reliable, fair and realistic assessment that reflects the KSAs required for competent job performance. For existing credentials, a job analysis should be performed periodically to maintain the validity of the content on the exam.

Professional Testing, Inc. conducted a JTA workshop with a group of 12 SMEs to identify the duties, tasks, steps and essential knowledge, skills, and attributes associated with the job performed by a multifamily energy auditor.

Following the JTA workshop, Professional Testing developed an online study to validate the initial results of the study and finalize a content outline. The online validation study was started by 144 participants and completed by 111 multifamily energy auditors across the United States.

Job/Tasks Analysis Workshop

The multifamily energy auditor JTA workshop was held in Lakewood, Colorado, May 9–11, 2013.

The first day of the workshop consisted of an introduction to the DACUM process. A 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 introduction was followed by a discussion about multifamily energy auditors, more specifically the "who, how, what, and why" of the profession. The SME panelists compiled this information into a comprehensive list to capture key multifamily energy auditor job components.

The next step was to identify duty (or domain) areas. The SME panelists identified duty areas and facilitators wrote the duty areas on large index cards and placed the duty areas on a wall for the whole group to see. Once panelists reached consensus on the duty areas, they delineated each duty by identifying the required tasks. After all the tasks were identified, they were ordered sequentially and entered onto a spreadsheet.

On the second day of the workshop, the facilitators projected a spreadsheet that contained the identified

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 that practitioners perform.**
- **All jobs can be effectively and sufficiently described in the terms of the tasks that successful workers perform.**
- **All tasks, to be performed correctly, demand certain knowledge, skills, abilities, attributes, and tools.**

duty areas and corresponding task statements. The facilitators asked the SMEs, while looking at the projected task list, to list the steps that occur under each task and to identify the KSAs, tools, equipment, and resources required to perform each task. This component of the job analysis process occupied the majority of time on the second day.

On the last day of the workshop, the SMEs finalized the remaining task statements and were asked to report how much of their time they spent on each of the duty and task areas. The SMEs rated each duty and task on the two dimensional scale shown in Figure 1.

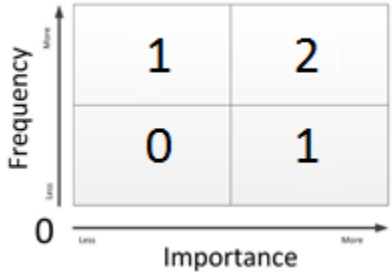

Figure 1. Two-dimensional scale for rating duties and tasks

The SMEs were asked to consider each task in terms of frequency and importance. Specifically, study respondents were asked to consider whether the tasks were performed more or less frequently, as well as if the tasks were more or less important to perform successfully as a minimally competent multifamily energy auditor. The SMEs were asked to select a number from zero to two based on the two dimensions of frequency and importance.

The mean frequency and importance ratings were calculated for all of the SME panelists and a preliminary content outline was developed at the end of the 3-day workshop.

As a final activity, the SMEs reviewed and finalized the following overarching job description for multifamily energy auditors.

> The multifamily energy auditor is a building science and energy efficiency specialist who assesses multifamily building systems, and collects and analyzes energy use and building performance data, to develop a plan for reducing operating costs, and enhancing building performance while increasing occupant quality of life.

The job profile that results from the JTA workshop is a detailed and graphic portrayal of a multifamily energy auditor and was initially documented in the form of a draft job and task analyses report. The draft JTA report was used as the basis for the online validation study and appears in Appendix B.

JTA Workshop Attendees

SME Panelists

Jonathan Bluey
Project Manager
NRCERT / CHP Energy Solutions
Christiansburg, VA

Andrew Brooks
Director West Coast Operations
Association for Energy Affordability
Emeryville, CA

Lowell Chu
Engineer
City & County of San Francisco
Dept. of the Environment
San Francisco, CA

James Frank
E.U.C. QA/QC Program Manager
Richard Heath & Associates, Inc.
San Diego, CA

Miles Grosbard
Chair, Department of Architecture Design & Construction
Community College of Philadelphia
Philadelphia, PA

Gordon Hart
Consulting Engineer
International Association of Heat & Frost Insulators and Allied Workers
Shrewsbury, MA

Alastair Hood
CEO
Verdafero Inc.
San Francisco, CA

Courtney Moriarta
Senior Project Manager
SRA International
Greenwich, NY

Daniel Rieber
Weatherization Director
Northern Manhattan Improvement Corporation
New York, NY

John Santos
Project Manager/ Weatherization Project Manager/Energy Auditor
Aleutian Housing Authority
Anchorage, AK
Aleutian & Pribilof Islands

Justin Southwick
Green Building Design and Development
Tri-Star Homes, Inc.
Brentwood, TN

Daran Wastchak
President
D.R. Wastchak, LLC
Tempe, AZ

Meeting Facilitation

Professional Testing, Inc.

Reed Castle, Ph.D.
Tiffany Castellvi, Ph.D.

Job/Task Analysis Validation Study

Validation of the JTA workshop outcome is perhaps the single most important component of the JTA development process. It provides an opportunity for other industry experts to verify the accuracy of the job profile as defined by the representative sample of practitioners (SME panelists).

Once the JTA document formulated at the workshop had been reviewed by NREL, the online study validation was launched to collect feedback on the frequency and importance ratings of the job tasks identified by the JTA workshop panelists and to capture any additional tasks and comments believed by respondents to pertain to the job of a multifamily energy auditor.

A copy of the validation study announcement is included in Appendix C.

Development of Demographic Questions for the Online Validation Study

The first step in developing the online validation study was to identify key demographic questions to capture the representativeness of study respondents and help evaluate the validity of study responses. Each participant was asked ten demographic questions:

1. What is the size of your organization?
2. In which state do you work?
3. In which sector do you currently work?
4. Which of the following jobs have you held in the multifamily (MF) building sector?
5. Which of the following categories best describes your current position?
6. How many years of experience have you had working as a multifamily energy auditor (total combined years)?
7. How many years of total experience do you have in the multifamily building industry (all jobs)?
8. What is your highest completed level of education?
9. To what professional societies/organizations do you belong?
10. What building performance credentials do you currently hold?

Development of Task-Rating Scales for the Online Validation Study

The second step in developing the online validation study was to identify the rating scales that survey participants use to rate the tasks performed by a multifamily energy auditor. There are multiple models of rating scales used in job analyses; however, for the purposes of this study, two study scales were used: task frequency and importance.

Task frequency was chosen because tasks performed more often should receive more emphasis, as identified in Newman, Slaughter, and Taranath (1999). Task importance was chosen because it is the most common scale used to evaluate tasks for licensure and certification job analysis (Newman et al. 1999) and as illustrated in the *Standards for Educational and Psychological Testing* (American Educational Research Association 1999), “the content domain to be covered

by a credentialing test should be defined clearly and justified in terms of the importance of the content for credential-worthy performance in an occupation or profession" (AERA, APA, NCME, 1999, p. 161). The two rating scales used for the validation study are illustrated in Table 1.

Table 1. Rating Scales

Frequency—How frequently is this task performed?	Importance—How important is this task to the performance of the job?
1: Never	1: Not important
2: Perform occasionally	2: Somewhat important
3: Perform fairly often	3: Important
4: Perform very often	4: Very important

An overall rating scale was calculated using the following formula:

Overall rating scale = 2*Importance + Frequency

The overall rating scale was used to develop weights for the duties and tasks within the content outline.

Administration of the Online Validation Study

Study participants received an email invitation (with a URL link to the study) from NREL that (1) invited them to participate in a nationwide research study investigating the practices, characteristics, and activities of four multifamily building job categories and (2) encouraged them to take this opportunity to directly contribute to the development of the multifamily home energy upgrade workforce.

The initial email invitation was sent June 19, 2013 to approximately 3,290 multifamily SMEs either directly from NREL, through the Guidelines e-newsletter mailing list, or through a Building Performance Institute, Inc. (BPI) mailing list. The announcement was also posted to DOE's Weatherization and Intergovernmental Program news website[1] (which received 25 page views during the validation study) and the Home Energy Pros Forum on July 1, 2013 (which received 235 page views on the Home Energy Pros Blog & Forum during the study).

Reminder notices were staggered and sent the weeks of July 8, 2013 and July 15, 2013, announcing the closing date of July 19, 2013. Approximately 1,450 reminder emails were sent directly to multifamily SMEs. In addition, Economic Opportunities Studies, Inc. (EOS) posted the announcement on their Facebook page, and received 194 "likes" and an announcement was made during a DOE/EOS webinar on July 12, 2013 that was attended by 150 individuals.

NREL also made approximately 150 phone calls to the multifamily JTA workshop participants, applicants, and SME list members, encouraging them to participate and to inform other

[1] http://www1.eere.energy.gov/wip/news.html

multifamily professionals. These calls were made on Thursday, July 11, 2013 and Friday, July 12, 2013 and on Monday, July 15, 2013 and Tuesday, July 16, 2013.

Notices announcing an extension of the validation study were sent on July 22, 2013 and July 23, 2013. These 6,363 emails were sent directly to SMEs, and several partnering organizations were asked to forward the extension notice; only SPEER (30), BPI (1,964) and EOS (4,300) confirmed they had forwarded the notice (their estimated numbers are included in the total above).

In addition to NREL's outreach, the Association for Energy Affordability, Inc. (AEA) made approximately 10 phone calls specifically to building operators asking for their participation; AEA's direct links to those working in the multifamily industry drove up the numbers of participants in the extended week of the study, enabling the minimum participation mark of 40 to be attained in the job designations of building operator, retrofit project manager, and quality control inspector.

In total, approximately 8,667 emails were sent to multifamily SMEs and to industry association members and mailing list affiliated with the multifamily retrofit industry over the course of the validation study. In addition, 604 contacts were made via page views, Facebook "likes," and the DOE/EOS webinar announcement. There is potential for significant overlap in these lists, and the multifamily SME contacts that NREL used are likely to be on at least one or two of the other lists and possibly more.

All of the study participants had access to internet-capable computers via their home, employment, or public library. Any computer with a web browser and a web connection could be used to access the study.

The online validation study for the multifamily energy auditor consisted of 51 job tasks separated into 10 content domains (or duty areas). A copy of the study is included in Appendix D.

Results

Online Validation Study

Study Respondent Demographics

The validation study respondents make up the study sample. The background and demographic portions of the online validation study help determine how representative the study sample is of the population of interest. The multifamily energy auditor study sample consisted of 144 respondents, with 111 completing the survey.

One hundred and forty-four participants answered the question about the size of their organizations. Of the 144 respondents, 66% worked at organizations with fewer than 50 people, as illustrated in Figure 2.

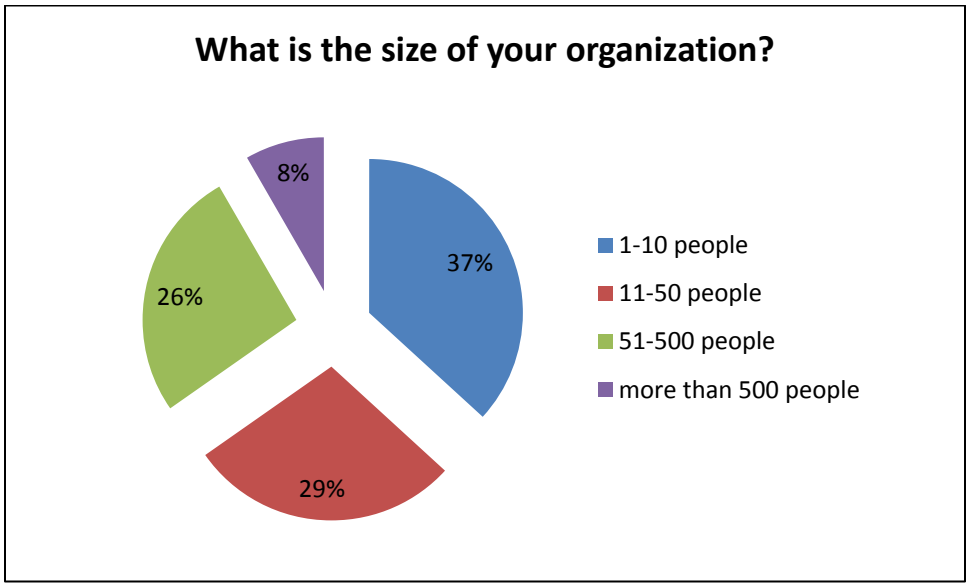

Figure 2. Sizes of organization of respondents

The 144 study respondents represented 32 states, with 17 respondents indicating they worked in multiple states. It was determined that this geographic distribution provided an adequate representation for the industry since 7 of the 8 U.S. mainland climate regions were represented by respondents. Table 2 contains the responses to this question and shows the geographic distribution of study respondents.

Table 2. States in which Respondents Reported Working

States	Number of Respondents
Arizona	1
Arkansas	1
California	10
Colorado	6
Connecticut	1
Georgia	3
Illinois	2
Indiana	1
Kansas	1
Maine	3
Maryland	1
Massachusetts	2
Michigan	2
Minnesota	3
Missouri	5
New Mexico	1
New York	47
North Carolina	3
North Dakota	1
Ohio	1
Oregon	1
Pennsylvania	8
Rhode Island	1
South Carolina	1
Tennessee	4
Texas	1
Utah	1
Vermont	1
Virginia	5
Washington	3
West Virginia	1
Wisconsin	5
Multiple States	17
Grand Total	144

Next, study respondents were asked to report the sector in which they worked at the time of the survey. Most respondents (72%) reported they worked in the private sector. Figure 3 shows the results of this question.

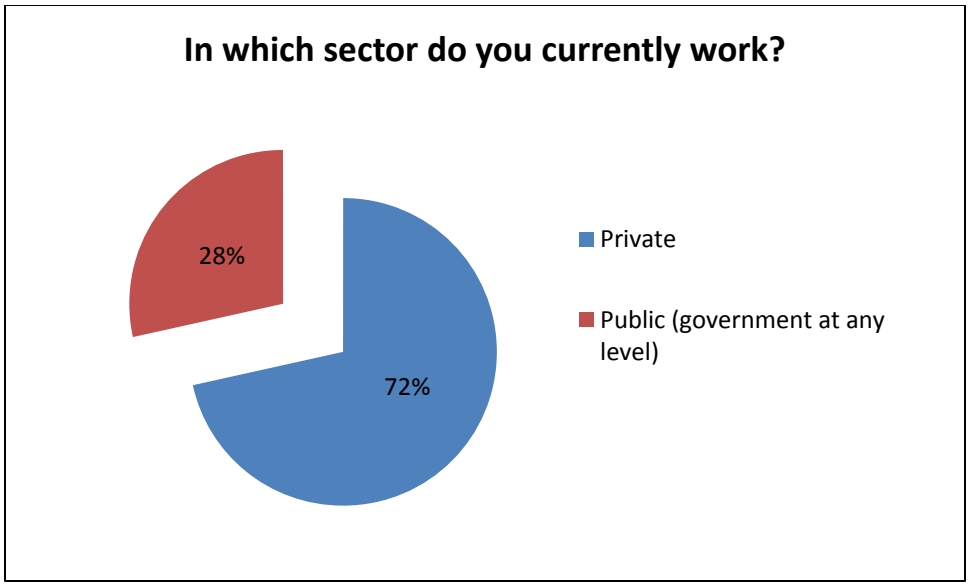

Figure 3. Sector in which respondents were working

Study respondents were then asked what jobs they had held in the multifamily building sector. Most respondents (94%) indicated they had worked as an energy auditor in the multifamily building sector. The distribution of different jobs is displayed in Figure 4. (Note that respondents could select multiple jobs, so the total percentage exceeds 100%).

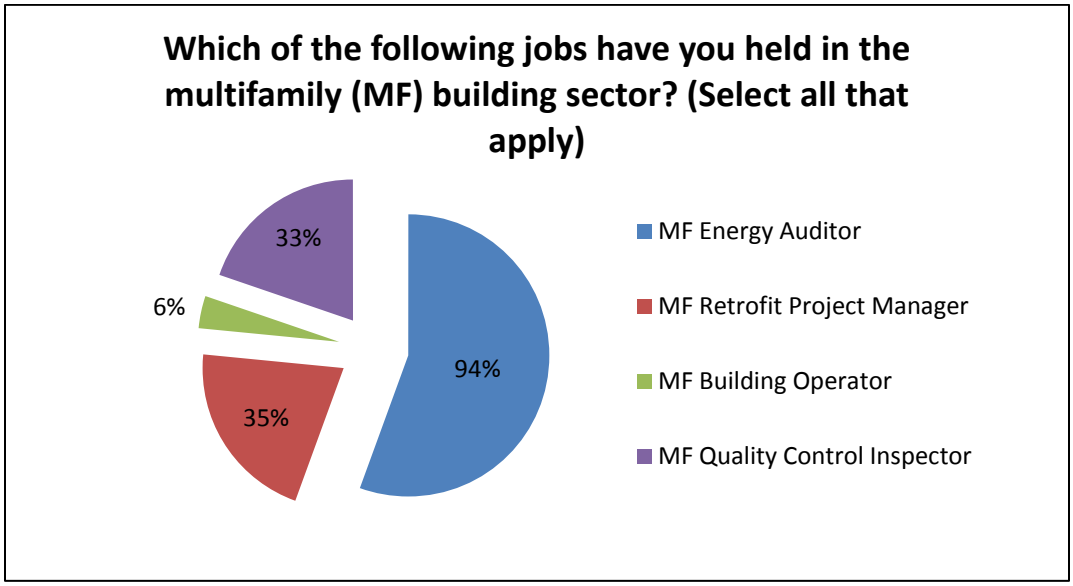

Figure 4. Jobs held by respondents in the multifamily building sector

When respondents were asked to categorize their current position, most (57%) selected "MF Energy Auditor Inspection Practitioner." The distribution of job categories is displayed in Figure 5.

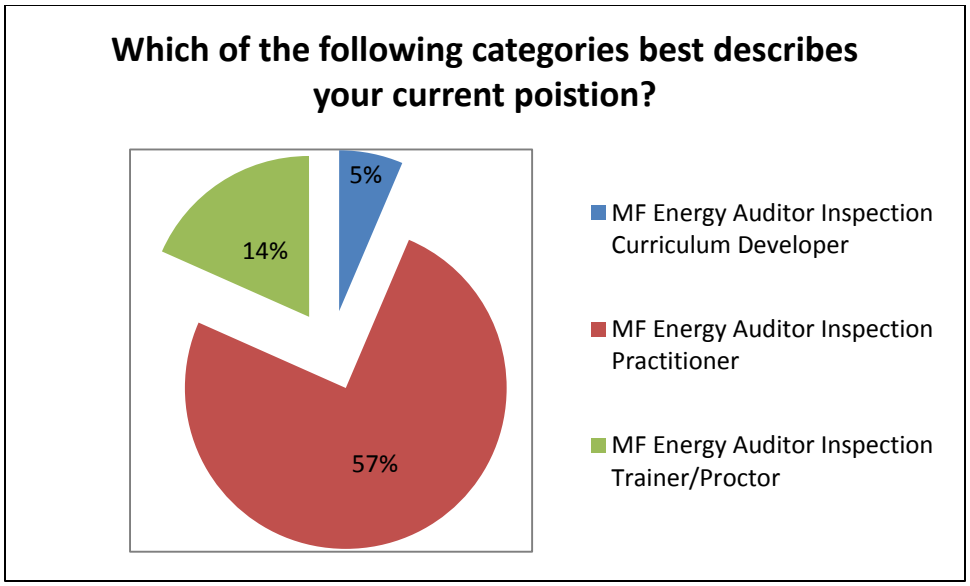

Figure 5. Categories of current jobs held by respondents

The study results suggest a wide range of experience from the participants working as a multifamily energy auditor. However, the largest percentage of study respondents (47%) reported working 5 years or fewer as a multifamily energy auditor. Figure 6 displays these results.

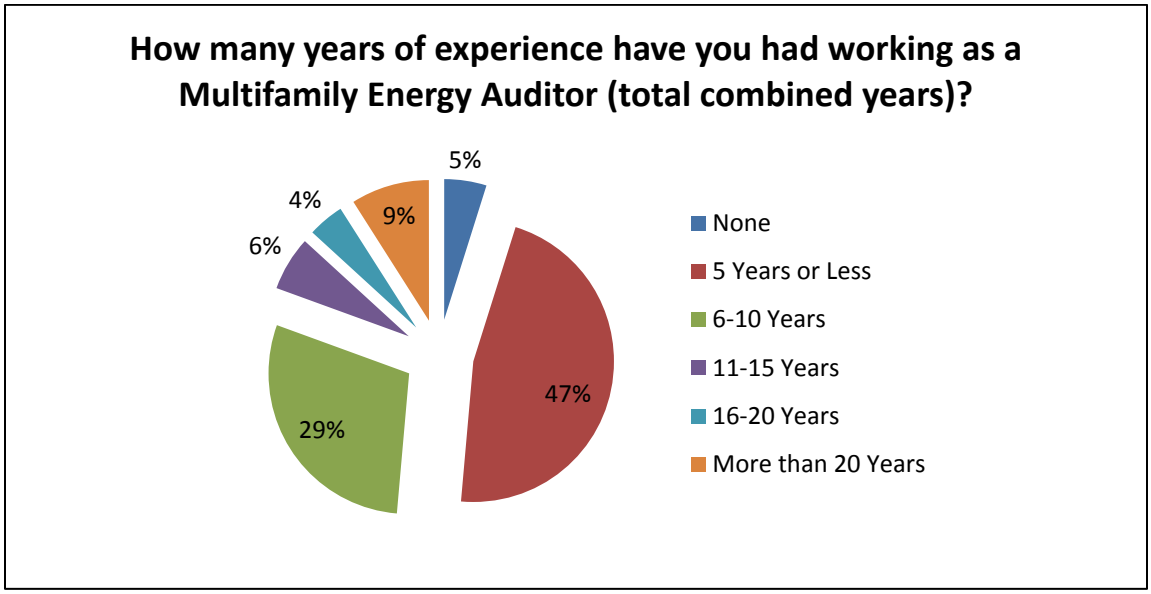

Figure 6. Years of experience respondents had as multifamily energy auditors

Most respondents (57%) indicated they had less than 10 years of total experience in the multifamily building industry (all jobs). However, study respondents were well represented across all levels of experience in the multifamily building industry as a whole with 20% of respondents stating that they had more than 20 years of experience in the multifamily industry. Figure 7 displays these results.

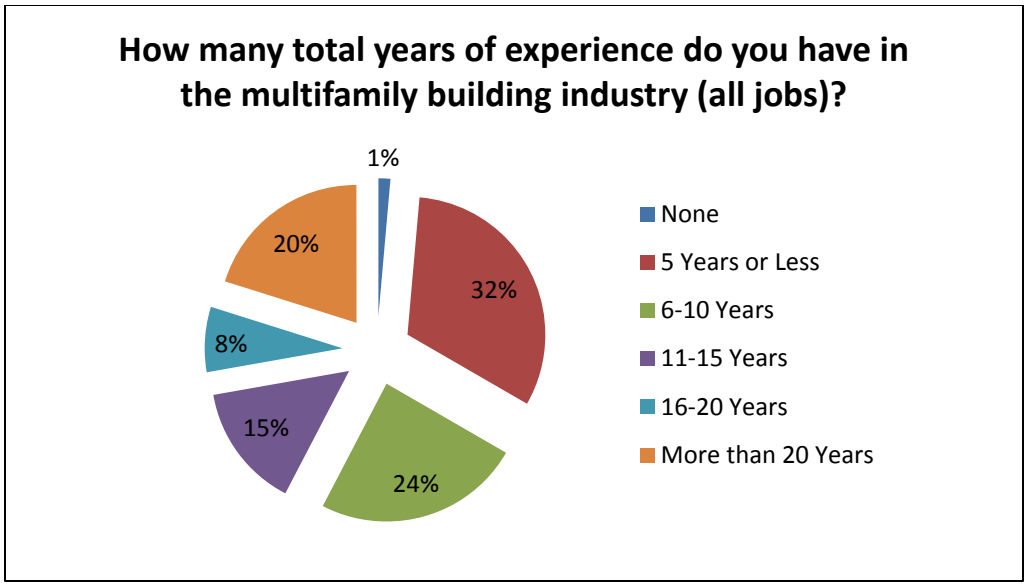

Figure 7. Years of experience respondents had in industry

Next, study respondents were asked to report their highest levels of completed education. Most respondents (46%) indicated a bachelor's degree was their highest level of education, and this group was closely followed by those having a graduate degree (33%). Figure 8 displays these results.

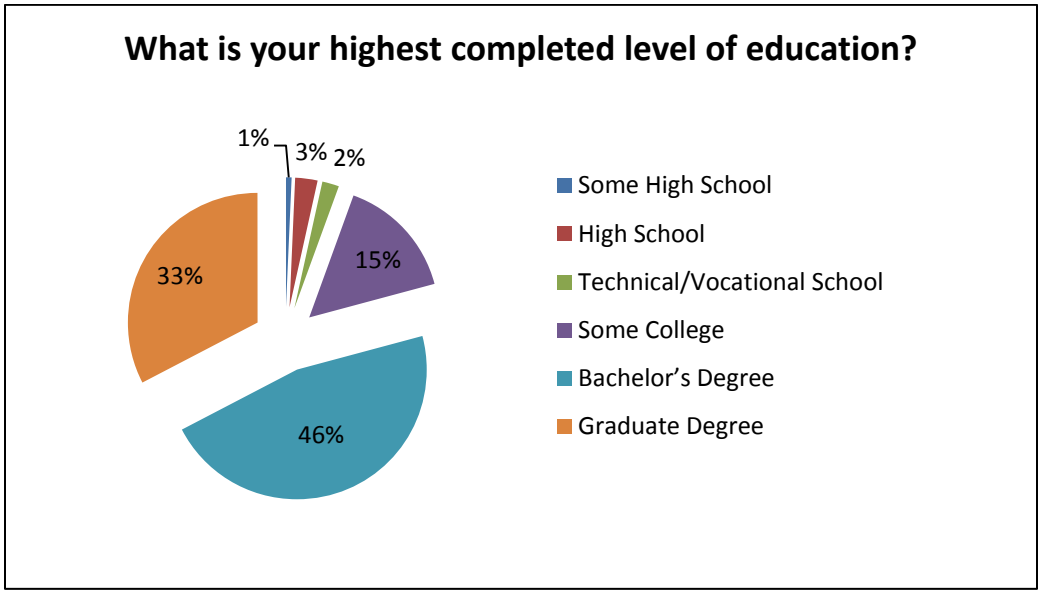

Figure 8. Highest levels of education completed by respondents

Study respondents were asked to report the professional societies and organizations they belonged to and were allowed to select more than one. The largest number of respondents (42) indicated they belonged to the Association of Energy Engineers (AEE) followed closely behind by 39 respondents indicating they belonged to the U.S. Green Building Council (USGBC), as illustrated by Table 3.

Table 3. Professional Societies and Organizations to which Respondents Belonged

Society or Organization	Number of Respondents
None	48
AABC Commissioning Group (ACG)	0
American Institute of Architects (AIA)	3
American Society of Civil Engineers (ASCE)	2
American Society of Mechanical Engineers (ASME)	5
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)	30
APPA	1
Association for the Advancement of Cost Engineering (AACE)	0
Association for Facilities Engineering	1
Association of Energy Engineers (AEE)	42
Building Commissioning Association (BCA)	2
Building Owners and Managers Association (BOMA)	6
Construction Specifications Institute (CSI)	0
International Association of Plumbing and Mechanical Officials (IAPMO)	1
International Building Performance Simulation Association (IBPSA)	5
International Code Council (ICC)	5
International Facility Management Association (IFMA)	2
International Union of Operating Engineers (IUOE)	0
Institute of Electrical and Electronics Engineers (IEEE)	0
Laborers' International Union of North America (LIUNA)	0
National Fire Protection Association (NFPA)	3
National Institute of Building Sciences (NIBS)	0
Service Employees International Union	1
Sheet Metal Workers' International Association (SMWIA)	0
United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (UA)	0
United Brotherhood of Carpenters	0
United Steelworkers (USW)	0
U.S. Green Building Council (USGBC)	39
Other Professional Organizations	31

Study respondents were also asked about their current building credentials. The largest number of respondents (76) indicated they held the BPI Building Analyst credential, and this group was followed closely by 70 candidates that indicated they held the BPI Multifamily Professional credential. Table 4 provides the complete list of credentials and number of respondents who reported having each credential.

Table 4. Multifamily Building Credentials of Respondents

Credentials	Number of Respondents
None	14
AABC Commissioning Group Certified Commissioning Authority (CxA)	0
AABC Commissioning Group Certified Commissioning Technician (CxT)	0
American Society of Heating, Refrigerating and Air-Conditioning Engineers Building Energy Modeling Professional (BEMP)	0
American Society of Heating, Refrigerating and Air-Conditioning Engineers Commissioning Process Management Professional (CPMP)	2
American Society of Heating, Refrigerating and Air-Conditioning Engineers Operations and Performance Management Professional (OPMP)	2
Association for Facilities Engineering Certified Plant Engineer (CPE)	0
Association for Facilities Engineering Certified Plant Maintenance Manager (CPMM)	0
Association for Facilities Engineering Certified Plant Supervisor	0
Association of Energy Engineers Certified Building Energy Simulation Analyst (BESA)	2
Association of Energy Engineers Certified Building Commissioning Professional (CBCP)	2
Association of Energy Engineers Certified Energy Auditor (CEA)	9
Association of Energy Engineers Certified Energy Manager (CEM)	32
Association of Energy Engineers Existing Building Commissioning Professional (EBCP)	11
Association of Energy Engineers Energy Manager in Training (EMIT)	0
Association of Energy Engineers/Efficiency Valuation Organization Certified Measurement and Verification Professional	3
BOMI International Facilities Management Administrator (FMA)	0
BOMI International Real Property Administrator (RPA)	0
BOMI International Systems Maintenance Administrator (SMA)	0
BOMI International Systems Maintenance Technician (SMT)	0
BPI Energy Auditor	30
BPI Retrofit Installer	3
BPI Crew Leader	2
BPI Quality Control Inspector	9
BPI Building Analyst	76
BPI Envelope Professional	48
BPI Residential Building Envelope Whole House Air Leakage Control Installer	9
BPI Manufactured Housing Professional	5
BPI Heating Professional	16

Credentials	Number of Respondents
BPI Air Conditioned Heat Pump Professional	4
BPI Multifamily Professional	70
Building Commissioning Association Certified Commissioning Professional (CCP)	0
Building Operator Certification – Level I (BOC Level I)	3
Building Operator Certification – Level II (BOC Level II)	0
The City University of New York Energy Management and Indoor Air Quality Certification	0
Energy Audit Institute Commercial Energy Audit Certification	0
General Professional Accreditations Licensed Architect	1
General Professional Accreditations Professional Engineer (PE)	8
International Facility Management Association Facility Management Professional (FMP)	0
International Facility Management Association Certified Facility Manager (CFM)	0
National Energy and Sustainability Institute Commercial Energy Auditor Certification	0
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U.S. Green Building Council LEED AP BD+C	13
U.S. Green Building Council LEED AP Homes	5
U.S. Green Building Council LEED AP ID+C	1
U.S. Green Building Council LEED AP ND	0
U.S. Green Building Council LEED AP O+M	5
U.S. Green Building Council LEED Green Associate	15
Other Building performance credential	38

Lastly, study respondents were asked how they heard about the study. Most respondents (74%) indicated they heard about the study through direct email invitations, as illustrated in Figure 9.

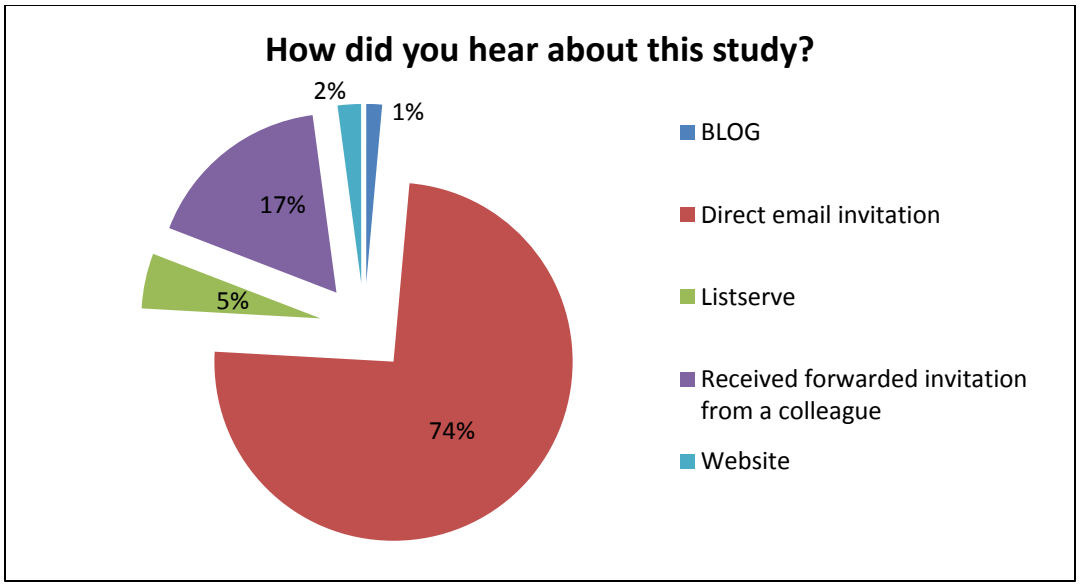

Figure 9. How respondents heard about the study

Overview of Study Respondents' Ratings for Task Statements

The mean ratings for task frequency ranged from 2.05 to 3.90, and the mean importance ratings ranged from 2.30 to 3.89. The standard deviation (SD) of the mean was calculated for each task to illustrate how closely the study responses tracked to each task mean. In other words, the smaller the SD, the more clustered the study responses are in relation to the mean and conversely, the greater the SD, the less clustered the study responses are in relation to the mean.

The standard error of the mean (SEM) was also computed for each of the task statements. The average of ratings of all tasks had a standard error of 0.08 (frequency ratings) and 0.7 (importance ratings), indicating that if the study were repeated with a different sample of study respondents the same results would be expected. Table 5 contains the results of the frequency and importance ratings as well as associated standard error of the means.

Table 5. Means and Standard Errors of Frequency and Importance Task Ratings

Duties and Tasks	Frequency			Importance		
	Mean	SD	SEM	Mean	SD	SEM
Determining Scope of Energy Assessment						
Interview client to determine objectives	3.54	0.73	0.06	3.68	0.59	0.05
Collect scoping data	3.47	0.77	0.07	3.51	0.68	0.06
Determine feasibility of audit scope	3.27	0.86	0.08	3.30	0.81	0.07
Establish scope of services	3.40	0.88	0.08	3.59	0.67	0.06
Preparing for Site Visit						
Review building plans	2.79	0.90	0.08	2.97	0.87	0.08
Perform utility bill analysis	3.45	0.81	0.07	3.58	0.69	0.06
Perform site visit planning	3.34	0.83	0.07	3.24	0.82	0.07

Duties and Tasks	Frequency			Importance		
	Mean	SD	SEM	Mean	SD	SEM
Assessing Heating and Cooling System						
Identify heating and cooling systems	3.83	0.49	0.04	3.89	0.38	0.03
Assess heating and cooling distribution system	3.63	0.67	0.06	3.66	0.58	0.05
Assess heating and cooling controls	3.66	0.68	0.06	3.69	0.56	0.05
Assess heat-related health and safety conditions	3.23	0.90	0.08	3.30	0.87	0.08
Assess cooling-related health and safety conditions	2.68	1.00	0.09	2.96	1.00	0.09
Conduct heating and cooling system performance evaluation	3.28	0.90	0.08	3.52	0.66	0.06
Review heating and cooling operations and maintenance procedures	2.92	0.92	0.08	3.21	0.80	0.07
Assessing Building Enclosure						
Assess wall assembly	3.34	0.88	0.08	3.33	0.78	0.07
Assess roof and attic assembly	3.60	0.69	0.06	3.52	0.68	0.06
Assess window and door types	3.69	0.62	0.06	3.32	0.80	0.07
Assess foundation and floor system condition	3.06	0.97	0.09	3.03	0.95	0.09
Test envelope infiltration	2.67	1.01	0.09	3.10	0.86	0.08
Evaluate enclosure health and safety conditions	3.10	1.05	0.10	3.19	0.96	0.09
Review enclosure operations and maintenance procedures	2.45	1.01	0.09	2.57	0.93	0.09
Evaluating Lighting Conditions						
Identify lighting system types	3.70	0.68	0.06	3.60	0.66	0.06
Assess lighting controls	3.37	0.89	0.08	3.35	0.79	0.07
Conduct lighting performance assessment	2.75	1.09	0.10	2.92	0.93	0.09
Evaluate lighting health and safety conditions	2.40	1.09	0.10	2.63	0.99	0.09
Review lighting operations and maintenance procedures	2.41	1.08	0.10	2.56	0.98	0.09
Assessing Indoor Air Quality and Ventilation System						
Assess type of ventilation system	3.64	0.66	0.06	3.67	0.56	0.05
Assess ventilation distribution system	3.35	0.89	0.08	3.43	0.78	0.07
Assess ventilation controls	3.38	0.87	0.08	3.50	0.74	0.07
Conduct ventilation performance assessment	2.76	1.07	0.10	3.12	0.84	0.08
Evaluate ventilation requirements	3.11	0.99	0.09	3.31	0.84	0.08
Identify potential hazard sources	3.18	0.95	0.09	3.26	0.89	0.08
Review ventilation operations and maintenance procedures	2.74	0.96	0.09	2.94	0.83	0.08

Duties and Tasks	Frequency			Importance		
	Mean	SD	SEM	Mean	SD	SEM
Assessing Additional Loads and Sources						
Identify additional loads	2.94	0.94	0.09	2.94	0.89	0.08
Identify additional water loads	2.61	1.03	0.10	2.73	0.95	0.09
Conduct performance assessment for additional loads and sources	2.32	0.96	0.09	2.53	0.89	0.08
Evaluate health and safety conditions for additional loads and sources	2.13	0.97	0.09	2.42	0.97	0.09
Assess operations and maintenance procedures for additional loads and sources	2.05	0.88	0.08	2.30	0.85	0.08
Assessing Domestic Hot Water Systems						
Identify domestic hot water systems	3.90	0.35	0.03	3.77	0.49	0.05
Assess domestic hot water distribution system(s)	3.57	0.78	0.07	3.51	0.71	0.07
Evaluate health and safety conditions for domestic hot water system	3.39	0.88	0.08	3.39	0.85	0.08
Conduct domestic hot water system performance assessment	3.12	1.03	0.10	3.09	0.88	0.08
Measure water consumption	2.54	1.14	0.11	2.83	0.86	0.08
Review domestic hot water operations and maintenance procedures	2.55	1.06	0.10	2.72	0.90	0.09
Developing an Energy Performance Plan						
Generate list of energy conservation measures	3.88	0.43	0.04	3.84	0.46	0.04
Generate list of non-energy conservation measures	3.00	1.00	0.09	3.06	1.03	0.10
Create energy performance plan report	3.42	0.90	0.08	3.48	0.82	0.08
Performing Post-Audit Activities						
Provide owner construction assistance	2.64	0.99	0.09	3.06	0.99	0.09
Verification of installed measures	2.97	1.02	0.10	3.32	0.93	0.09
Complete programmatic documentation	2.89	1.04	0.10	2.99	0.99	0.09
Assist with post-retrofit education	2.32	0.92	0.09	3.10	0.86	0.08

Reliability of Tasks Ratings

To determine the reliability of the frequency and importance task ratings, Cronbach's alpha was computed for both the frequency and importance scales. Cronbach's alpha ranges from zero to one and is affected by the number of questions and the number of respondents. An alpha value greater than 0.70 is considered acceptable, one greater than 0.80 is considered good, and one greater than 0.90 is considered excellent. For this study, the frequency scales had an alpha of 0.95, and the alpha for the importance scale was 0.96. These values indicate that the frequency and importance ratings for each of the tasks have excellent reliability and we can be confident that, as a whole, if these tasks were rated again by the same respondents the same results would be obtained.

Results of Post-Validation Review Meeting

A subgroup of the original SME panel for the multifamily energy auditor workshop was convened via webinar and conference call on August 8, 2013 to conduct the following activities:

- Ensure that appropriate and representative individuals responded to the study as understood by the SME panel subgroup
- Review the tasks identified as having low combined ratings (thus indicating they were ranked low in frequency, importance, or both) to determine whether the tasks should be removed
- Review study respondent comments to determine if any tasks were missed during the JTA meeting
- Determine the final content outline

The post-validation study participants were as follows:

- Brooks, Andrew
- Chu, Lowell
- Hood, Alastair
- Moriarta, Courtney
- Santos, John
- Southwick, Justin
- Wastchak, Daran.

Review of Study Respondent Demographics

The post-validation study meeting participants reviewed the demographic information associated with the study participants and determined that a representative sample of individuals responded to the study. In other words, the post-validation study meeting participants—after reviewing summarized demographic data for the respondents—felt that the group of respondents adequately reflected the profession.

Review of Low-Rated Tasks

The purpose of this activity was to direct SME attention to the tasks that were rated lower by the study respondents and to discuss those tasks to ensure they belonged on the final content outline. Tasks that had a combined mean frequency and importance rating below 8.00 (implying that the task is performed less than "occasionally" and is less important) were flagged for review during the post-study webinar.

The frequency and importance data was combined to form a single scale using the formula below:

Overall rating scale = 2*Importance + Frequency

Importance ratings were given extra weight in the combined scale. This is because while both frequency of task performance and task importance are both valuable rankings in certification credentialing examinations, importance is often thought of as having more bearing and therefore, should receive greater emphasis in the content outline. Seven tasks received a criteria rating below 8 (listed in italics), as illustrated in Table 6, and were reviewed by the reconvened SME panelists.

Based on the frequency and importance ratings of the validation study, the post-validation study meeting participants decided to keep all seven of the identified tasks, as they were determined to be important to the job of a multifamily energy auditor and should therefore remain in the final content outline.

Table 6. Combined Means and Frequencies of Duties and Tasks

Duties and Tasks	Frequency Mean
Determining Scope of Energy Assessment	
Interview client to determine objectives	10.90
Collect scoping data	10.48
Determine feasibility of audit scope	9.88
Establish scope of services	10.57
Preparing for Site Visit	
Review building plans	8.72
Perform utility bill analysis	10.60
Perform site visit planning	9.83
Assessing Heating and Cooling System	
Identify heating and cooling systems	11.61
Assess heating and cooling distribution system	10.96
Assess heating and cooling controls	11.03
Assess heat-related health and safety conditions	9.84
Assess cooling-related health and safety conditions	8.60

Duties and Tasks	Frequency Mean
Conduct heating and cooling system performance evaluation	10.33
Review heating and cooling operations and maintenance procedures	9.33
Assessing Building Enclosure	
Assess wall assembly	10.01
Assess roof and attic assembly	10.64
Assess window and door types	10.34
Assess foundation and floor system condition	9.11
Test envelope infiltration	8.87
Evaluate enclosure health and safety conditions	9.48
Review enclosure operations and maintenance procedures	*7.59*
Evaluating Lighting Conditions	
Identify lighting system types	10.91
Assess lighting controls	10.07
Conduct lighting performance assessment	8.58
Evaluate lighting health and safety conditions	*7.65*
Review lighting operations and maintenance *procedures*	*7.54*
Assessing Indoor Air Quality and Ventilation System	
Assess type of ventilation system	10.98
Assess ventilation distribution system	10.21
Assess ventilation controls	10.38
Conduct ventilation performance assessment	9.00
Evaluate ventilation requirements	9.74
Identify potential hazard sources	9.70
Review ventilation operations and maintenance procedures	8.62
Assessing Additional Loads and Sources	
Identify additional loads	8.81
Identify additional water loads	8.07
Conduct performance assessment for additional loads and sources	*7.37*
Evaluate health and safety conditions for additional loads and sources	*6.97*
Assess operations and maintenance procedures for additional loads and sources	*6.65*
Assessing Domestic Hot Water Systems	
Identify domestic hot water systems	11.43
Assess domestic hot water distribution system(s)	10.60
Evaluate health and safety conditions for domestic hot water system	10.17

Duties and Tasks	Frequency Mean
Conduct domestic hot water system performance assessment	9.30
Measure water consumption	8.20
Review domestic hot water operations and maintenance procedures	*7.98*
Developing an Energy Performance Plan	
Generate list of energy conservation measures	11.55
Generate list of non-energy conservation measures	9.13
Create energy performance plan report	10.37
Performing Post-Audit Activities	
Provide owner construction assistance	8.76
Verification of installed measures	9.60
Complete programmatic documentation	8.87
Assist with post-retrofit education	8.52

Review of Missing Tasks and Additional Comments

Study respondents were given an opportunity to identify tasks they felt were missing from the content provided in the online validation study. Six respondents submitted tasks, and all such items are included in Table 7. The post-validation study meeting participants reviewed each task and determined whether the content was already covered in the existing DACUM chart or whether it was outside the scope of professional practice. If it was not covered, the SMEs were asked to add the task to the job description. All missing tasks identified by the study respondents were already addressed or outside the scope of the profession. To that end, no additional tasks were added.

Table 7. Tasks Identified by Study Respondents as Missing from the JTA Task List[a]

Missing Tasks
Talking about project timelines, costs and being able to handle a lot of questions. I do MF audits for the WI WAP and since I am the first person they ussualy meet property owners and managers have lots of questions besides the audit related one that I need to be able to answer.
client relationship building. Contractor interaction. Bid process, other systems which were not included.
(1) Calibrate assumed energy usage against recent utility data, calibrate heating, cooling and baseloads individually. (2) calibrate assumed potential energy savings against recent utility data that has been dis-aggregated into baseload / cold-weather loads and hot-weather loads, and calibrate savings against known performance data for that type of improvement. (3) List required energy performance attributes of recommended improvements in the report (4) Interview residents regarding O&M procedures and issues. (5) Obtain many samples of indoor temperature data if visiting during heating or cooling season.
1. Unless these are included in the Energy Performance Plan mentioned: Cost issues; SIR; ROI; payback; Life Cycle evaluation. 2. Codes 3. Benchmarking
Set up on-going/monitoring based commissioning system for major mechanical equipment, M&V Protocol and reporting, connecting work order system with fault detection and diagnostics.
create an energy model of the building analyze the financial impact of energy conservation measures

Missing Tasks
Conduct solar site survey - assessment for ease of system installation Provide low-cost green - sustainable recommendations
Building modeling in RemDesign or TREAT to establish budget for the cost effective portion of energy conservation measures. Negotiations with landlords about measures recommended versus measures desired, and their required contribution for the non-cost effective portion of desired measures. Since I work for a WAP agency I spend a lot of time obtaining signatures from landlords and/or tenants releasing the government of liability for hazards of weatherization or potentially defective smoke and carbon monoxide detectors; and documenting their reception of various educational brochures (lead paint, mold and moisture).
if you look at a multi-family on it from a private sector perspective it is usually energy engineer driving trade experts through the process. I realize this process is slanted towards programmatic multi-family energy auditors. but the tasks are simila. The belief that one person can accomplish a complete multi-family energy audit doesn't really exist in the private sector where are often times results are guaranteed. There you have a competent engineer utilizing the experts within a specific trade to put together a package tha t can be hopefully be sold to an interesred owner. sorry for any typos this is being done on my cell phone.
Energy Modeling; Cost Estimation; Life Cycle Cost Analysis and Cost Effectiveness; Technology Research and Continuing Education; Renewable Opportunity Evaluation
Build energy model or calculate energy savings from proposed measures. Calculate payback of proposed measures. Estimate costs. Interview tenants and on-site personnel.
Assessing of drainage systems and site grading.
Commissioning services
Verify plans with existing conditions
Water consuming devices and potential retrofits--not energy but very cost important
outside limits on audit scope: determine when specialist assessment or destructive testing is required; or usual audit tasks are not relevant to this building or climate, NA
energy modeling/quantitative analyses.
Cost Estimates Building Code Awareness Duct System Flows/ Manual J Computer Modeling Skills
Educating operators and management on proper equipment operation, maintenance and management.
Part of "Developing an Energy Performance Plan" should include questions 1) Interactive savings predictions made using an energy simulation tool. 2) Calibrating the baseline energy simulation model to the baseline energy usage from the utility bill analysis before reporting any savings predictions. 3) Reporting of cost savings and therefore cost-effectiveness ratios (e.g. SIR, SPP, IRR) are based on the marginal energy rates, not the average energy rates as determined by analyzing the rate structure(s) of the energy meters affected by each improvement.
1-year post-construction fuel analysis - fairly often, important Assess budgetary constraints - very often, very important
In our program we right ECM specs, then the building owners get bids from sub contractors. We review the bids and report on what is acceptable (from a technical perspective.) Selecting a good sub contractor is critical and we spend a fair amount of time communicating with them.
retro commissioning
no mention of metrics, analytical measurement methods and verification.
Lots this is main stream only

Missing Tasks
Asses and advise on fuel switch options and fuel supplier options as well as renewable options including solar, co-gen and geothermal. Also asses heating system conbustion air and venting systems and controls
Finance assistance
Energy modeling to determine SIR heath & safety measures - non energy related. Durability inspection
Data collection to support modelling and energy modeling
this did not directly address the very important tasks of Q&A with the mgmt, operator, and residents. Also, investigating the Htg &/or cooling distribution system, as well as specific problems the mgmt/operators have with the systems.
Use of energy modeling software Cost assessment of proposed energy saving options
Under Preparing for Site Visit, I would include Review site history. By this I mean how the building was built and has changed over its life. Under Assessing Building Enclosure, I would add Test Interstitial Infiltration.
Assisting owner with specification development and financing of the project.
Measure ventilation rates
pre-visit utility bill analysis and benchmarking
Chillers/Air Conditioning
Creating energy model, assessing utility bills to identify opportunities, cost effectiveness assessment, measure viability review, internal quality reviews, research into new technologies, review of current codes, collection of post-retrofit data and data logging (as part of the initial visit)
Commissioning
Assessing the feasibility and appropriateness of renewables and distributed generation: solar, wind, CHP
New construction is missing almost entirely from here, which I think is strange.
air seal/insulation standards
Iterfacing with the owner during a project CNA replacement schedual to better provide conservation specifications to the planned renovation or upgrades.
Duct inspections, etc; CO, Combustion Area Zone inspections, etc
Filtration assessment

[a] Tasks are noted in their original format, without edits, to maintain their integrity.

Lastly, study respondents were given an opportunity to provide additional comments. Fifteen respondents submitted comments, and all such items are included in Table 8. Upon reviewing the submissions, the post-validation study meeting participants determined that the comments specifically related to duties and tasks were already addressed by the proposed content outline.

Table 8. Additional Comments Identified by Study Respondents

Additional Comments1
My focus has been primarily on medium-sized buildings (5-20 units). I don't often encounter complex mechanical systems. In markets with large, multistory buildings, the ability to evaluate these systems becomes more important.
Our role is limited by constraints of a utility program under which we work.
some tasks are more involved and could have several parts, but the overall scope of the tasks is close enough
for this process to be useful it should really focus on private sector is well as public sector multi-family energy audit activities.This will require more specific focus on each individual tasks such as lighting, water conservation, controls, ventilation, heating, air conditioning, and building envelope. within the private sector analysis of each of these individual systems are generally performed by competent trades people conjunction with an engineer overseeing the process. the idea that one person to do all this with the private sector would be laughed at and scored for the most part. Very few people are able to perform competent analysis on even a few of these issues within the context of a real energy audit. Ass a contractor the biggest fear I have is looking at a scope to bid on that is incomplete or designed to be "kind of fleshed out" by the contractors through the bidding process. What's this delivers to the client is a non apples to apples scope with focus on least cost.This often drives value and results away from the tablevand re as ults in poor performance. when we have confronted several energy on orders regarding their scopes they claim it's impossible for them to determine the exact amount number Ect of whatever needs to be done. this is because her expertise is placed them into a situation where they are incompetent. this is not a sustainable model outside of the public sector. no offense intended. please excuse any typos is this is from my cell phone.
Working on utility-funded program so there is minimal reimbusement on non-fuel saving measures-unfortunately
no time now. probably OK, but when to get help is missing. how beginning audit staff can recognize and report or refer atypical opportunities and risks is .
As I replied "Very Important" and "Very often performed" to most questions, this does not seem to be that useful feedback. It would really help and possibly be more informative to know when each of those task are important and how often performed depending the type of multifamily audit. How often these task are performed depends on who the audit is for (i.e. for owner, for the program, private sector, public sector). Also depends on the improvements being evaluated (e.g. auditor should only minimal time to know avg size, count and performance characteristics of windows if not evaluating for replacement, but much more time and detail if evaluating replacement).
were the questions about "conduct performance" to determine if retro-commissiong is included in an energy audit process?
Not sure how to interpret the "Additional Loads" questions.
What does it do for cust?
I understand IR to be part of the building enclosure assessment process. If you did not then your survey is incomplete. The process should use Thermorgaphers certified to the ASNT Level I or Level II criteria.
As a Professional, we are limited by Clients decisions about what tasks/scope they are willing to pay for are usually driven by legal requirements or program requirements -rarely driven by "whats the right

Additional Comments1
thing/best thing to do"
A number of subtasks seemed duplicative. If I am going to assess the health and safety of a system then I am also going to performance test it and review the O&M procedures, all of which are equally important.
Apparrantly needed more field experienced people in initial group.
We need a way to engage tenants and facilities management without creating perceived costs or inconvenience.

[a] Comments are noted in their original format ,without edits. to maintain their content.

Final Weighting of Task List and Proposed Content Outline

The post-validation study meeting participants reviewed the results of the study and compared them to the proposed content outline that resulted from the original JTA meeting. Table 9 contains the content outline and task weights proposed by the JTA panelists (column labeled SME Weights) as well as the content outline resulting from the validation study (column labeled Study Weights).

Table 9. Comparison of Validation Study Results with JTA SME Panelists Weights

Duties and Tasks	Overall Ratings	Study Weights	SME Weights
Determining Scope of Energy Assessment		8.6%	5%
Interview Client to Determine Objectives	10.90	2.2%	2%
Collect Scoping Data	10.48	2.2%	1%
Determine Feasibility of Audit Scope	9.88	2.0%	1%
Establish Scope of Services	10.57	2.2%	1%
Preparing for Site Visit		6.0%	5%
Review Building Plans	8.72	1.8%	2%
Perform Utility Bill Analysis	10.60	2.2%	2%
Perform Site Visit Planning	9.83	2.0%	1%
Assessing Heating and Cooling System		14.8%	15%
Identify Heating and Cooling Systems	11.61	2.4%	3%
Assess Heating and Cooling Distribution System	10.96	2.3%	3%
Assess Heating and Cooling Controls	11.03	2.3%	3%
Assess Heat-Related Health and Safety Conditions	9.84	2.0%	2%
Assess Cooling-Related Health and Safety Conditions	8.60	1.8%	1%
Conduct Heating and Cooling System Performance Evaluation	10.33	2.1%	1%
Review Heating and Cooling Operations and Maintenance Procedures	9.33	1.9%	2%
Assessing Building Enclosure		13.6%	13%
Assess Wall Assembly	10.01	2.1%	2%

Duties and Tasks	Overall Ratings	Study Weights	SME Weights
Assess Roof and Attic Assembly	10.64	2.2%	2%
Assess Window and Door Types	10.34	2.1%	2%
Assess Foundation and Floor System Condition	9.11	1.8%	2%
Test Envelope Infiltration	8.87	1.8%	2%
Evaluate Enclosure Health and Safety Conditions	9.48	2.0%	2%
Review Enclosure Operations and Maintenance Procedures	7.59	1.6%	1%
Evaluating Lighting Conditions		9.2%	9%
Identify Lighting System Types	10.91	2.2%	2%
Assess Lighting Controls	10.07	2.1%	2%
Conduct Lighting Performance Assessment	8.58	1.8%	2%
Evaluate Lighting Health and Safety Conditions	7.65	1.6%	2%
Review Lighting Operations and Maintenance Procedures	7.54	1.5%	1%
Assessing Indoor Air Quality and Ventilation System		14.2%	12%
Assess Type of Ventilation System	10.98	2.3%	2%
Assess Ventilation Distribution System	10.21	2.1%	2%
Assess Ventilation Controls	10.38	2.1%	2%
Conduct Ventilation Performance Assessment	9.00	1.9%	2%
Evaluate Ventilation Requirements	9.74	2.0%	2%
Identify Potential Hazard Sources	9.70	2.0%	1%
Review Ventilation Operations and Maintenance Procedures	8.62	1.8%	1%
Assessing Additional Loads and Sources		7.8%	9%
Identify Additional Loads	8.81	1.8%	2%
Identify Additional Water Loads	8.07	1.7%	2%
Conduct Performance Assessment for Additional Loads and Sources	7.37	1.5%	2%
Evaluate Health and Safety Conditions for Additional Loads and Sources	6.97	1.4%	2%
Assess Operations and Maintenance Procedures for Additional Loads and Sources	6.65	1.4%	1%
Assessing Domestic Hot Water Systems		11.9%	13%
Identify Domestic Hot Water Systems	11.43	2.4%	3%
Assess Domestic Hot Water Distribution System(s)	10.60	2.2%	2%
Evaluate Health and Safety Conditions for Domestic Hot Water System	10.17	2.1%	2%
Conduct Domestic Hot Water System Performance Assessment	9.30	1.9%	2%
Measure Water Consumption	8.20	1.7%	2%
Review Domestic Hot Water Operations and Maintenance Procedures	7.98	1.6%	2%

Duties and Tasks	Overall Ratings	Study Weights	SME Weights
Developing an Energy Performance Plan		6.4%	14%
Generate List of Energy Conservation measures	11.55	2.4%	5%
Generate list of Non-Energy Conservation Measures	9.13	1.9%	4%
Create Energy Performance Plan Report	10.37	2.1%	5%
Performing Post-Audit Activities		7.4%	5%
Provide Owner Construction Assistance	8.76	1.8%	1%
Verification of Installed Measures	9.60	2.0%	2%
Complete Programmatic Documentation	8.87	1.8%	1%
Assist with Post-Retrofit Education	8.52	1.8%	1%

After much discussion, the content outline and weighting was finalized, taking into consideration the results of the JTA meeting together with those of the validation study. The SMEs decided to keep the weighting they had developed at the JTA workshop. The final content outline appears in Table 10 and provides an initial basis from which an assessment (e.g., a certification or licensure examination) may be constructed; it also provides curriculum developers with a model to align training to the core needs of the occupation.

Table 10. Final Content Outline for Multifamily Energy Auditors

Duties and Tasks	Weighting
Determining Scope of Energy Assessment	5%
Interview Client to Determine Objectives	2%
Collect Scoping Data	1%
Determine Feasibility of Audit Scope	1%
Establish Scope of Services	1%
Preparing for Site Visit	5%
Review Building Plans	2%
Perform Utility Bill Analysis	2%
Perform Site Visit Planning	1%
Assessing Heating and Cooling System	15%
Identify Heating and Cooling Systems	3%
Assess Heating and Cooling Distribution System	3%
Assess Heating and Cooling Controls	3%
Assess Heat-Related Health and Safety Conditions	2%
Assess Cooling-Related Health and Safety Conditions	1%
Conduct Heating and Cooling System Performance Evaluation	1%
Review Heating and Cooling Operations and Maintenance Procedures	2%

Duties and Tasks	Weighting
Assessing Building Enclosure	13%
Assess Wall Assembly	2%
Assess Roof and Attic Assembly	2%
Assess Window and Door Types	2%
Assess Foundation and Floor System Condition	2%
Test Envelope Infiltration	2%
Evaluate Enclosure Health and Safety Conditions	2%
Review Enclosure Operations and Maintenance Procedures	1%
Evaluating Lighting Conditions	9%
Identify Lighting System Types	2%
Assess Lighting Controls	2%
Conduct Lighting Performance Assessment	2%
Evaluate Lighting Health and Safety Conditions	2%
Review Lighting Operations and Maintenance Procedures	1%
Assessing Indoor Air Quality and Ventilation System	12%
Assess Type of Ventilation System	2%
Assess Ventilation Distribution System	2%
Assess Ventilation Controls	2%
Conduct Ventilation Performance Assessment	2%
Evaluate Ventilation Requirements	2%
Identify Potential Hazard Sources	1%
Review Ventilation Operations and Maintenance Procedures	1%
Assessing Additional Loads and Sources	9%
Identify Additional Loads	2%
Identify Additional Water Loads	2%
Conduct Performance Assessment for Additional Loads and Sources	2%
Evaluate Health and Safety Conditions for Additional Loads and Sources	2%
Assess Operations and Maintenance Procedures for Additional Loads and Sources	1%
Assessing Domestic Hot Water Systems	13%
Identify Domestic Hot Water Systems	3%
Assess Domestic Hot Water Distribution System(s)	2%
Evaluate Health and Safety Conditions for Domestic Hot Water System	2%
Conduct Domestic Hot Water System Performance Assessment	2%
Measure Water Consumption	2%

Duties and Tasks	Weighting
Review Domestic Hot Water Operations and Maintenance Procedures	2%
Developing an Energy Performance Plan	14%
Generate List of Energy Conservation measures	5%
Generate list of Non-Energy Conservation Measures	4%
Create Energy Performance Plan Report	5%
Performing Post-Audit Activities	5%
Provide Owner Construction Assistance	1%
Verification of Installed Measures	2%
Complete Programmatic Documentation	1%
Assist with Post-Retrofit Education	1%
Total	100%

The validation study confirmed that the job description for a multifamily energy auditor developed and compiled by the 12 SME panelists was accurate and thorough. Specifically, the study validated the job-related tasks for a multifamily energy auditor that had been identified by the SME panelist during the 3-day workshop.

Analysis of the study data (study respondents' frequency and importance ratings of these job-related tasks) also provides a benchmark to evaluate the weighting of the content outline that had been developed by the SME panelists. This analysis provides greater assurance that the final content outline produced as part of this multifamily energy auditor JTA process can be used with confidence to develop credentialing programs and/or curriculum.

References

Raymond, M.R. (2001). "Job Analysis and the Specification of Content for Licensure and Certification Examinations." *Applied Measurement in Education* 14(4),; pp. 369—415.

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Appendix A. Opportunity Announcement

The National Renewable Energy Laboratory (NREL) and Professional Testing, Inc. are seeking participants for a three-day workshop in Denver, Colorado, to inventory the tasks and skills that best define the common body of required knowledge for workers in the multifamily housing sector.

To facilitate development of these multifamily-specific JTAs/KSAs, Professional Testing, Inc. is seeking current industry practitioners who have the experience and vision to help define and promote energy efficiency in the multifamily housing sector by participating in these JTA/KSA development workshops. Interested individuals are invited to submit their credentials by Monday, April 1st.

Please note that each JTA/KSA workshop is anticipated to last three full days (excluding travel). Reimbursement for travel costs up to a fixed amount, a travel per diem, and an honorarium will be awarded to individuals selected for participation. Please visit http://proftesting.rapidinsites.com for additional project details, including how practitioners will be selected and where to direct project-related questions.

NREL and Professional Testing, Inc. are excited to facilitate this unique, foundational opportunity for industry practitioners to provide their expertise and insight during this important development process. Thank you for your time.

Sincerely,
The NREL Home Energy Professionals Project Team

If you have any questions or comments about this email bulletin, please contact workforce.guidelines@nrel.gov.

Appendix B. Job/Task Analysis for a Multifamily Energy Auditor

This appendix was developed as a result of the JTA workshop and served as the foundation for building the online validation study.

In addition to providing historical reference, this initial product of the JTA process profiles the job of a multifamily energy auditor, and may also be used to develop training or examination content.

Multifamily Energy Auditor Job Description

The multifamily energy auditor is a building science and energy efficiency specialist who assesses multifamily building systems, and collects and analyzes energy use and building performance data, to develop a plan for reducing operating costs, and enhancing building performance while increasing occupant quality of life.

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

Multifamily Energy Auditor Duty Areas

A	Determining Scope of Energy Assessment
B	Preparing for Site Visit
C	Assessing Heating and Cooling System
D	Assessing Building Enclosure
E	Evaluating Lighting Conditions
F	Assessing Indoor Air Quality and Ventilation System
G	Assessing Additional Loads and Sources
H	Assessing Domestic Hot Water Systems
I	Developing an Energy Performance Plan
J	Performing Post-Audit Activities

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 (NREL) and was funded by DOE's Weatherization Assistance Program (WAP).

Introduction

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

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 appendix 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 multifamily energy auditor. 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 appendix was created by industry practitioners and is intended to portray the job of a multifamily energy auditor as currently practiced.

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, with NREL, established criteria to select SMEs from a larger applicant pool to ensure:

- Geographic (including regional/climatic) 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.

Twelve applicants meeting the above criteria were selected to create the multifamily energy auditor SME panel.

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.**

Job/Task Analysis Workshop

The multifamily energy auditor JTA workshop was held in Lakewood, Colorado, May 9–11, 2013.

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 multifamily energy auditors, more specifically the "who, how, what, and why" of the profession. The SME panelists compiled this information into a comprehensive list to capture key multifamily energy auditor 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 multifamily energy auditors.

Results

This appendix presents aspects of a multifamily energy auditor, as captured by the 12-member panel during the May 9–11, 2013 JTA workshop in Lakewood, Colorado. The tables that follow reflect job requirements and are meant to provide a clear understanding and detailed description of the work performed.

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.

Nomenclature

Table B-1 provides a list of the acronyms and abbreviations used in this appendix. 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 B-1. List of Acronyms and Abbreviations

Nomenclature	Definition
ACH	Air changes per hour
CFM	Cubic feet per minute
DACUM	Developing a curriculum
DHW	Domestic hot water
ECM	Energy conservation measures
EEM	Energy efficiency measures
IAQ	Indoor air quality
ICAT	Insulated-can, air-tight
JTA	Job/task analysis
MEP	Mechanical, electrical and plumbing
NACH	Natural air changes per hour
O&M	Operations and maintenance
PPE	Personal protective equipment
ROI	Return on investment
SIR	Savings to investment ratio
SOP	Standard operating procedure(s)
SME	Subject matter expert

Proposed Content Outline

The SMEs rated the list of job-related tasks composing 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 and tasks known as a *content outline*. After reviewing the results of their ratings, the SMEs made qualitative judgments as to how they would adjust the rating to reflect their practice.

The proposed content outline 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 B-2. Proposed Content Outline for Multifamily Energy Auditors

Duties and Tasks		Weighting	SME Suggested Weighting
A	Determining Scope of Energy Assessment	9.25%	5%
1	Interview client to determine objectives	2.41%	2%
2	Collect scoping data	2.31%	1%
3	Determine feasibility of audit scope	2.11%	1%
4	Establish scope of services	2.41%	1%
B	Preparing for Site Visit	6.33%	5%
1	Review building plans	2.11%	2%
2	Perform utility bill analysis	2.21%	2%
3	Perform site visit planning	2.01%	1%
C	Assessing Heating and Cooling System	14.97%	15%
1	Identify heating and cooling systems	2.41%	3%
2	Assess heating and cooling distribution system	2.31%	3%
3	Assess heating and cooling controls	2.31%	3%
4	Assess heat-related health and safety conditions	2.01%	2%
5	Assess cooling-related health and safety conditions	1.81%	1%
6	Conduct heating and cooling system performance evaluation	2.21%	1%
7	Review heating and cooling operations and maintenance procedures	1.91%	2%
D	Assessing Building Enclosure	14.27%	13%
1	Assess wall assembly	2.41%	2%
2	Assess roof and attic assembly	2.41%	2%
3	Assess window and door types	2.31%	2%
4	Assess foundation and floor system condition	2.01%	2%
5	Test envelope infiltration	1.91%	2%
6	Evaluate enclosure health and safety conditions	1.91%	2%
7	Review enclosure operations and maintenance procedures	1.31%	1%
E	Evaluating Lighting Conditions	9.45%	9%
1	Identify lighting system types	2.41%	2%
2	Assess lighting controls	2.31%	2%
3	Conduct lighting performance assessment	1.71%	2%
4	Evaluate lighting health and safety conditions	1.61%	2%
5	Review lighting operations and maintenance procedures	1.41%	1%
F	Assessing Indoor Air Quality and Ventilation System	13.97%	12%

Duties and Tasks		Weighting	SME Suggested Weighting
1	Assess type of ventilation system	2.21%	2%
2	Assess ventilation distribution system	2.11%	2%
3	Assess ventilation controls	2.01%	2%
4	Conduct ventilation performance assessment	2.11%	2%
5	Evaluate ventilation requirements	2.11%	2%
6	Identify potential hazard sources	1.81%	1%
7	Review ventilation operations and maintenance procedures	1.61%	1%
G	Assessing Additional Loads and Sources	7.74%	9%
1	Identify additional loads	1.91%	2%
2	Identify additional water loads	1.31%	2%
3	Conduct performance assessment for additional loads and sources	1.71%	2%
4	Evaluate health and safety conditions for additional loads and sources	1.61%	2%
5	Assess operations and maintenance procedures for additional loads and sources	1.21%	1%
H	Assessing Domestic Hot Water Systems	11.46%	13%
1	Identify domestic hot water systems	2.41%	3%
2	Assess domestic hot water distribution system(s)	2.21%	2%
3	Evaluate health and safety conditions for domestic hot water system	2.01%	2%
4	Conduct domestic hot water system performance assessment	2.11%	2%
5	Measure water consumption	1.21%	2%
6	Review domestic hot water operations and maintenance procedures	1.51%	2%
I	Developing an Energy Performance Plan	6.73%	14%
1	Generate list of energy conservation measures	2.41%	5%
2	Generate list of non-energy conservation measures	1.91%	4%
3	Create energy performance plan report	2.41%	5%
J	Performing Post-Audit Activities	5.83%	5%
1	Provide owner construction assistance	1.51%	1%
2	Verification of installed measures	1.71%	2%
3	Complete program documentation	1.51%	1%
4	Assist with post-retrofit education	1.11%	1%
		100.00%	100%

Knowledge

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

Table B-3. Specialized Knowledge Required of Multifamily Energy Auditors

Specialized Knowledge	
Action levels for pollutant mitigation	Additional loads and sources
Air pollutant mitigation options	Air pollutant sources
Air pollutants	Air sealing techniques
Apartment end uses	Asbestos identification
Auditing tools and equipment	Building construction types
Building science	Building systems and components
Burn hazards	Causes of pipe failure
Codes, standards, and regulations	Co-generation
Combustion efficiency	Combustion efficiency testing and inspections
Combustion safety testing and inspection protocols	Components of condensate discharge system
Construction bidding	Construction contracts and specifications
Construction process	Construction scheduling
Construction techniques	Cooling distribution types and components
Cooling SOPs	Cooling system controls
Cooling system types	Cost/benefit analysis
Costs for energy assessment services	Diagnostic equipment
Diagnostic tool purposes	Disposal requirements
Distribution system types and components	Domestic hot water SOPs
Domestic hot water system controls	Domestic hot water systems
Doors	Electrical hazards
Elevator mechanical room safety	Elevator system types
Energy assessment services	Energy assessment standards
Energy assessment tasks	Energy rebates and available programs
External resources	Financial analysis
Fire hazards	Flashing
Flooring material types	Fuel types

Specialized Knowledge	
Fuel units	Health and safety codes and regulations
Heating distribution types and components	Heating SOPs
Heating system controls	Heating system types
Illumination levels	Infiltration diagnostics
Insulation types	Internal capabilities
Jurisdictional codes and regulations	Lead paint risk
Leak control	Legionella
Light level requirements	Lighting characteristics
Lighting codes and standards	Lighting controls
Lighting levels	Lighting quality
Lighting SOPs	Lighting types
Local heating ordinances	Mechanical heating systems
Mechanical insulation types	Moisture movement
Moisture sources	Mold
Multifamily building types	Multifamily buildings and systems
O&M practices	O&M procedures
Organizational dynamics	Organizational qualifications
OSHA	Personal safety
Pests	Piping types and fittings
Plans/specifications	Pools/spas
Productivity rates	Program eligibility criteria
Pumps	Radon
Rebate and incentive programs	Rebates and incentives
Refrigerant types	Renewables
Roofing material types	Safety codes and standards
Sampling protocols	Signs of foundation failure
Signs of roofing failure	SOPs for additional loads and sources
Standard operating parameters for heating equipment and systems	Testing protocols
Thermography	Utility metering configurations
Utility rate structures	Utility sources
Ventilation codes and regulations	Ventilation codes and standards
Ventilation distribution types and components	Ventilation rate analysis
Ventilation SOPs	Ventilation system controls
Ventilation systems	Ventilation types

Specialized Knowledge	
Venting safety	Water delivery system
Water flow rates	Water rate structures
Water-efficient fixtures	Weather/climate characteristics
Windows	

Table B-4. General Knowledge Required of Multifamily Energy Auditors

General Knowledge	
Calculations	
Change numbers from fractions into decimals and back	Change numbers from percentages into decimals and back
Collect information to solve a problem	Compare numbers
Figure averages	Make rough estimates
Measure angles	Multiply and factor algebraic expressions
Perform angular calculations	Perform math operations using exponential numbers
Perform math operations using signed (positive and negative) numbers	Perform math operations using single and multiple digit numbers
Perform mathematical operations with decimals	Perform mathematical operations with fractions
Perform simple math operations of division	Perform simple math operations of multiplication
Perform simple math operations of subtraction	Solve formula calculations with more than one unknown
Solve formula calculations with one unknown	Solve percent problems
Solve problems with graphs	Solve ratio problems
Solve right triangle problems using Pythagorean theorem	Transfer number sequences from a source into a column
Use a calculator	
Basic Measurements	
Calculate the perimeter and areas of common figures	Convert measurements from one unit to another (English to Metric, etc.)
Estimate and approximate measurements	Find distances and directions on land maps
Find the dimensions of an object from a scale drawing	Make simple scale drawings
Measure area (square inches, square centimeters, etc.)	Measure board feet
Measure length to 1/16 of an inch	Measure linear distances (length, width, etc.)
Measure temperature to within 1 degree Fahrenheit	Measure volume (cubic inches, liters, etc.)
Measure weights using devices calibrated in pounds	Read and apply coefficient measurements indicated in a table or chart

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

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 multifamily energy auditor should possess (Table B-5).

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

Table B-5. Skills, Abilities, and Attributes Required of Multifamily Energy Auditors

Skills, Abilities, and Attributes	
Accurate/Precise	Adaptable/Flexible
Analytical	Appropriate dresser
Benchmarking	Blower door operation
Calculate energy consumption/production	Calibration
Carbon monoxide testing	Caring
Combustion safety testing	Common sense
Communication	Compassionate
Confident	Conscientious
Cooperative	Cost/benefit analysis
Courteous	Crawl
Create drawings	Creative
Critical thinking	Customer-oriented
Data interpretation	Data logging
Decision-making	Dependable
Detail-oriented	Diagnostic testing
Documentation	Eager to learn new things
Empathetic	Energy modeling
Energy unit conversion	Enthusiasm
Estimating	Ethical
Evaluation	Focused
Free of substance abuse	Friendly
Goal-oriented	Helpful
Honest	Industrious
Initiative	Integrity
Interpersonal	Interviewing
Leader	Listening
Literacy	Manage stress/pressure
Mathematics	Measurement
Meticulous	Multitasking
Neat	Negotiation
Non-aggressive	Observation

Skills, Abilities, and Attributes	
Open-minded to change	Organizational
Patience	Persistence
Personal hygiene	Physical stamina
Planning	Positive attitude
Presentation	Pride in job
Problem solving	Professional
Punctual	Quality focused
Read plans/specifications	Read utility/fuel bills
Research	Respectful
Responsible/accountable	Safety conscious
Sales	Scheduling
Self-control	Self-discipline
Self-esteem	Self-motivated
Sensitive to thoughts of others	Sketching
Social skills	Tactful
Team player	Time management
Tolerant	Training
Trustworthy	Verbal communication
Work efficiently (resources)	Work efficiently (time)
Work in confined spaces	Work in teams
Written communication	

Physical Conditions

In any job, the environment in which tasks are completed and the specific physical requirements necessary to complete each task must be understood. Awareness of physical conditions is useful for a variety of purposes, including ergonomic design, safety analysis, and the identification of job elements that are deemed essential functions for compliance with The Americans with Disabilities Act.

Table B-6 contains the list of panelist-recommended physical conditions a multifamily energy auditor should possess.

Table B-6. Physical Conditions Recommended for Multifamily Energy Auditors

Physical Conditions	
Bend forward frequently	Carry Objects of up to 50 pounds
Climb ladders, stairs, poles, etc. using legs and/or arms	Crawl or creep
Detect abnormal noises	Feel size, shape and temperature or texture of objects with the hands
Handle hot or cold objects	Hear speech
Hold or move objects using the fingers	Hold or move objects using the hands but not the fingers
Judge depth (the position and distance of objects) with the eyes	Lay on back
Lift 50 pounds maximum	Lift objects from ground to overhead level
Lift objects from ground to waist level	Lift objects from waist to overhead level
Pull objects with arms or hands	Push objects with arms or hands
Reach with arms and hands in any direction	See clearly at 20 feet or more (with/without optical assistance)
See clearly at 20 inches or less (with/without optical assistance)	Sit part of the time
Stand all of the time	Stand at all (could the work be performed from a sitting position?)
Stand part of the time	Stoop kneel or crouch
Talk	Walk
Work around or near high voltage power sources or equipment	Work at heights of 1 to 25 feet above ground or floor level
Work at heights of 26 to 75 feet above ground or floor level	Work at heights of 76 feet or higher above ground or floor level
Work in a squatting position for more than 5 minutes per hour	Work in changing temperatures (in and out of buildings repeatedly)
Work in confined spaces	Work in damp places (high humidity, some standing water)
Work in dry places (lacking any natural moisture or humidity)	Work in dust, oils, fumes, or smells
Work in high temperatures (85 to 130 degrees Fahrenheit)	Work in low temperatures (0 to 45 degrees Fahrenheit)
Work in noisy places (85 decibels or higher with ear protection)	Work inside
Work on slippery surfaces	Work outside
Work while sitting or standing on high roofs, overhangs, or I-beams	Work while standing on portable ladders
Work while standing on scaffolding	Work while wearing protective equipment

Physical Conditions	
	(respirators, hoods, etc.)
Work with hands and arms over head level	Work with or near fiberglass or asbestos materials

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 B-7 lists the panelist-identified inventory of tools, equipment, and resources necessary to perform the identified tasks.

Table B-7. Tools, Equipment, and Resources Used by Multifamily Energy Auditors

Tools, Equipment, and Resources	
General Tools, Equipment, and Resources	
Architect scale	Auditing tools and equipment
Benchmarking software	Calculator
Clipboard	Codes and regulations
Computer	Conversion calculators
Diagnostic tools	Digital camera
Drafting software	Drop camera
Dye tablets	Energy performance plan
Equipment manuals	Flashlight
Flow capture device	Intake form/checklist
Internet	Ladder
Mirror	Modeling software
Navigation services/maps	O&M templates
PPE	Program application forms
Proposal template	Report template
Sample audit report	Schedule template
Scheduling software	Scheduling template
Service pricing schedule	Spreadsheet software
Stop watch	System diagrams
Telephone	Thermometer
Word processing software	
Additional Loads and Sources	
Apartment's end uses (e.g., Refrigerator, Cooking Appliances, Dishwasher, Window Units)	Co-generation (Source)

Tools, Equipment, and Resources	
Common area equipment (e.g., Kitchens, Laundry, BBQ, Vending Machines)	District Energy (source)
Elevator	Office Uses
Pool/Spa Equipment	Pumps
Solar Photovoltaic (Source)	Solar Thermal (Source)
Space heater	Trash equipment
Water features	
Diagnostic Tools	
Air flow capture device	Anemometer
Balometer	Blower door
Borescope	Carbon monoxide monitor
Combustion analyzer	Data logger
Digital camera	Duct blaster
Exhaust flow hood	Flicker checker
Flow container	Gas leak detector
Hygrometer	Infrared camera
Light meter	Low-E detector
Manometer	Moisture meter
Multimeter	Occupancy sensor
Pressure pan	Refrigerant gauge
Refrigerant leak detector	Smoke pencil
Stroboscope	Tape measure
Thermometer	Watt meter
Building Documentation	
Apartment schedule	Architectural building drawings
As-built building drawings	Capital improvement plan
Electrical drawings	Existing code violations
Floor plan drawings	Fuel records/Utility bills
Mechanical drawings	Operations and maintenance records
Plumbing drawings	Pressure balance reports
Proposed building drawings	Rent rolls
Repair history	Service contracts
Structural drawings	
Personal Protective Equipment (PPE)	
Disposable coverall	Dust mask

Tools, Equipment, and Resources	
Ear plugs	Gloves
Hard hat	Knee pads
Personal carbon monoxide detector	Respirator
Safety glasses	Safety harness
Shoe covers	Steel-toed boots

DACUM Chart

The DACUM chart (Table B-8) 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 B-8. DACUM Chart for Multifamily Energy Auditors

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
A	Determining Scope of Energy Assessment			
1	Interview Client to Determine Objectives			
a	Identify potential services	Energy assessment services Energy rebates and available programs Multifamily building types Organizational dynamics Utility sources	Interpersonal Interviewing Listening Verbal communication	Computer Internet Navigation services/maps Sample audit report Service pricing schedule Telephone
b	Establish stakeholder objectives			
c	Identify decision-making structure			
d	Request available documentation			
e	Discuss client schedule			
f	Obtain general building description			
g	Discuss budget for the energy assessment			
h	Discuss budget for recommended improvements			
i	Obtain site address			
2	Collect Scoping Data			
a	Request building stakeholder contact list	Jurisdictional codes and regulations Multifamily buildings and systems Plans/specifications Program eligibility criteria Utility metering configurations Weather/climate characteristics	Documentation Interviewing Read plans/specifications Research	Codes and regulations Intake form/checklist Program application forms
b	Obtain building documentation (e.g., floor plan)			
c	Identify specific characteristics of the building			
d	Conduct initial walkthrough			
3	Determine Feasibility of Audit Scope			
a	Screen for program eligibility	Energy assessment services Energy assessment standards	Analytical Cost/benefit analysis	Scheduling software
b	Determine client funding resources			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
c	Manage client scope deliverable expectations	External resources Internal capabilities Program eligibility criteria	Planning Scheduling	
d	Identify preliminary costs/benefits			
e	Identify internal capacity to meet client needs			
4	Establish Scope of Services			
a	Determine staffing needs	Costs for energy assessment services Diagnostic tool purposes Organizational qualifications Productivity rates	Create drawings Estimation Negotiation Planning Presentation Sales Scheduling	Calculator Proposal template Scheduling software Spreadsheet software
b	Determine scheduling of tasks			
c	Determine testing needs			
d	Determine list of services			
e	Determine availability of detailed drawings			
f	Create proposal for services			
g	Present proposal to client			
h	Execute contract			
B	Preparing for Site Visit			
1	Review Building Plans			
a	Obtain building drawings	Building science Building systems and components	Create drawings Literacy Mathematics Measurement Read plans/specifications	Architect scale Drafting software
b	Obtain equipment schedules			
c	Review building drawings			
d	Review equipment schedules			
e	Review fenestration schedules			
f	Complete initial quantity takeoffs			
g	Identify areas to be inspected			
h	Review capital improvement plan			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
2	Perform Utility Bill Analysis			
a	Obtain release of utility/fuel records	Building science Fuel types Fuel units Utility metering configurations Utility rate structures	Benchmarking Energy unit conversion Mathematics Read utility/fuel bills	Benchmarking software Calculator Conversion calculators Spreadsheet software
b	Collect utility/fuel records			
c	Enter utility/fuel record data into energy analysis tool			
d	Disaggregate utility/fuel bill information by end use			
e	Review rate structure			
f	Perform benchmarking			
3	Perform Site Visit Planning			
a	Survey building staff about building performance	Auditing tools and equipment Energy assessment tasks O&M procedures Sampling protocols	Communication Scheduling	Auditing tools and equipment Navigation services/maps
b	Schedule site visit appointment			
c	Schedule interviews with vendors and staff			
d	Generate sampling plan			
e	Obtain entry permissions from occupants			
f	Provide general overview of audit process			
g	Request access to O&M documentation			
h	Request occupancy information			
i	Coordinate auditing staff			
j	Designate audit equipment			
C	Assessing Heating and Cooling System			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
1	Identify Heating and Cooling Systems			
a	Conduct visual inspection of heating/cooling system(s)	Building science Cooling system types Fuel types Heating system types Refrigerant types	Documentation Observational	Clipboard Schedule template System diagrams
b	Record name plate data			
c	Record age of heating/cooling system(s)			
d	Identify fuel source			
e	Identify heating/cooling medium			
f	Photograph heating/cooling system(s)			
g	Draw a mechanical room sketch			
h	Create heating/cooling equipment schedule			
i	Visually inspect heating/cooling equipment conditions			
j	Inspect for gas leaks			
2	Assess Heating and Cooling Distribution System			
a	Identify heating/cooling distribution types and components	Building science Cooling distribution types and components Heating distribution types and components Mechanical heating systems Mechanical insulation types	Documentation Observational	Clipboard Flashlight Mirror PPE
b	Diagram heating/cooling piping/ducts			
c	Identify mechanical heating/cooling insulation type and condition			
d	Identify mechanical heat insulation coverage			
e	Visually inspect for leaks			
f	Identify heating/cooling terminal unit			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
	type			
g	Identify evaporative water loss from cooling towers			
h	Visually inspect for wet insulation			
3	Assess Heating and Cooling Controls			
a	Identify heating/cooling plant controls	Cooling system controls Heating system controls Local heating ordinances Refrigerant types	Calibration Documentation Observational	Clipboard Flashlight Thermometer
b	Identify heating/cooling terminal controls			
c	Identify heating/cooling distribution controls			
d	Document heating/cooling controls settings/programming			
e	Locate heating/cooling controls			
f	Evaluate calibration of heating/cooling controls			
4	Assess Heat-Related Health and Safety Conditions			
a	Identify potential asbestos-containing materials	Asbestos identification Combustion safety testing and inspection protocols OSHA	Combustion safety testing	Diagnostic tools PPE
b	Perform combustion safety tests			
c	Identify potential fire hazards			
d	Identify scald/burn hazards			
5	Assess Cooling-Related Health and Safety Conditions			
a	Visually inspect for unobstructed condensate discharge	Components of condensate discharge system	Documentation	Diagnostic tools

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
b	Visually inspect for condensation on chilled water pipes	OSHA	Observational	PPE
c	Inspect for standing water or mold			
d	Inspect for refrigerant leaks			
6	Conduct Heating and Cooling System Performance Evaluation			
a	Perform combustion efficiency test	Building science Combustion efficiency Standard operating parameters for heating equipment and systems Testing protocols Distribution system types and components	Diagnostic testing	Diagnostic tools Equipment manuals Flow capture device PPE
b	Evaluate combustion makeup air			
c	Perform duct leakage testing			
d	Perform duct static pressure testing			
e	Perform supply and return airflow testing			
f	Record supply and return temperatures			
g	Perform room/zone pressure balance testing			
h	Verify functionality of steam traps or vents			
i	Verify airflow across the coil			
j	Verify refrigerant charge test has been completed by licensed professional			
7	Review Heating and Cooling Operations and Maintenance Procedures			
a	Review O&M logs	Cooling SOPs Heating SOPs	Interviewing Verbal communication	
b	Review SOPs			
c	Interview maintenance staff			
D	Assessing Building Enclosure			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
1	Assess Wall Assembly			
a	Visually inspect of wall(s)	Building construction types Building science Insulation types Moisture movement Moisture sources	Communication Measurement Observation Sketching	Diagnostic tools
b	Measure the dimensions of the walls			
c	Verify that drawings and dimensions are accurate			
d	Verify insulation presence and type			
e	Visually inspect via holes within wall(s)			
f	Perform infrared scan			
g	Visually inspect for areas of water penetration			
h	Measure moisture content on (?) surfaces			
i	Evaluate vapor barrier			
j	Evaluate shading			
k	Draw a sketch to document wall assembly			
l	Assess intentional penetration			
2	Assess Roof and Attic Assembly			
a	Evaluate the thermal barrier	Building construction types Building science Insulation types Moisture movement Moisture sources Roofing material types Signs of roofing failure	Communication Measurement Observation Sketching Work in confined spaces	Diagnostic tools Flashlight Ladder PPE
b	Evaluate the pressure barrier			
c	Verify the condition of the insulation			
d	Evaluate ventilation within the space			
e	Evaluate vapor barrier			
f	Draw a sketch to document roof/attic assembly			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
g	Identify thermal bridging			
h	Evaluate integrity of the roof			
i	Evaluate the weather barrier			
j	Verify proper drainage/moisture management on roof			
k	Measure dimensions of roof			
l	Document access location to roof/attic			
m	Assess intentional penetration			
3	Assess Window and Door Types			
a	Evaluate types of windows	Construction techniques Doors Flashing Windows	Communication Measurement Observation Sketching	Diagnostic tools Flashlight Ladder PPE
b	Evaluate types of doors			
c	Identify manufacturer and model numbers			
d	Evaluate condition of window units			
e	Evaluate condition of door units			
f	Test for low E coating			
g	Evaluate the integrity of window opening			
h	Evaluate the integrity of door opening			
i	Measure window dimensions			
j	Measure door dimensions			
k	Evaluate shading			
l	Create window and door schedule			
4	Assess Foundation and Floor System Condition			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
a	Evaluate the thermal barrier	Building construction types Building science Flooring material types Insulation types Moisture movement Moisture sources Signs of foundation failure	Communication Crawl Measurement Observation Sketching Work in confined spaces	Diagnostic tools Flashlight PPE
b	Evaluate the pressure barrier			
c	Verify the condition of the insulation			
d	Evaluate ventilation within the space			
e	Evaluate vapor barrier			
f	Draw a sketch to document floor/foundation assembly			
g	Identify thermal bridging			
h	Evaluate integrity of the floor/foundation			
i	Evaluate the weather barrier			
j	Verify proper drainage/moisture management			
k	Measure dimensions of floor/foundation			
l	Document access location to crawl space or basement			
m	Assess intentional penetration			
5	Test Envelope Infiltration			
a	Perform infiltration test	Air sealing techniques Building science Infiltration diagnostics Thermography	Analytical Blower door operation Decision-making Planning Problem solving	Diagnostic tools
b	Identify location of infiltration (air) leaks			
c	Perform zonal tests (e.g., pressure mapping)			
d	Evaluate compartmentalization of spaces			
e	Perform infrared thermography			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
f	Determine air exchange rates			
g	Evaluate shielding			
6	Evaluate Enclosure Health and Safety Conditions			
a	Inspect for excess moisture	Asbestos identification Electrical hazards Health and safety codes and regulations Lead paint risk Mold Pests Radon	Documentation Interviewing Observation	Diagnostic tools PPE
b	Visually inspect for mold			
c	Inspect for electrical hazards			
d	Evaluate potential for radon			
e	Visually inspect for signs of pest activity			
f	Identify potential for lead paint (e.g., peeling)			
g	Identify potential asbestos-containing materials			
7	Review Enclosure Operations and Maintenance Procedures			
a	Review repair history	Enclosure SOPs	Interviewing Verbal communication	
b	Review complaint history			
c	Interview maintenance staff			
d	Interview residents			
E	Evaluating Lighting Conditions			
1	Identify Lighting System Types			
a	Conduct visual inspection of lighting system(s)	Illumination levels Lighting codes and standards Lighting types	Documentation	Clipboard Digital camera Schedule template
b	Photograph lighting system(s)			
c	Create lighting schematic			
d	Create lighting schedule/inventory			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
e	Visually inspect lighting conditions			
f	Identify daylighting conditions			
2	Assess Lighting Controls			
a	Identify lighting controls	Lighting controls	Calibration Documentation	Clipboard Digital camera
b	Document lighting control settings/programming			
c	Locate lighting controls			
d	Evaluate calibration of lighting controls			
3	Conduct Lighting Performance Assessment			
a	Measure lighting levels	Lighting characteristics Lighting codes and standards Lighting levels Lighting quality	Documentation	Clipboard Diagnostic tools Digital camera
b	Assess lighting quality			
c	Evaluate performance of lighting controls			
4	Evaluate Lighting Health and Safety Conditions			
a	Evaluate lighting safety and security conditions	Disposal requirements Light level requirements Lighting codes and standards	Documentation	Clipboard Digital camera
b	Verify use of IC-rated fixtures			
c	Identify proper lighting disposal			
5	Review Lighting Operations and Maintenance Procedures			
a	Review lighting O&M logs	Lighting SOPs	Interviewing Verbal communication	
b	Review lighting SOPs			
c	Interview maintenance staff			
F	Assessing Indoor Air Quality and Ventilation System			
1	Assess Type of Ventilation System			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
a	Identify ventilation system type(s)	Building science Ventilation codes and regulations Ventilation types	Documentation	Clipboard Digital camera Scheduling template
b	Identify ventilation system locations			
c	Identify ventilation system rated capacity			
d	Record name plate data			
e	Identify source of preconditioning for supply air			
f	Diagram ventilation system			
g	Create ventilation equipment schedule			
h	Visually inspect ventilation system condition			
2	Assess Ventilation Distribution System			
a	Identify ventilation distribution types and components	Building science Mechanical insulation types Ventilation distribution types and components Ventilation systems	Documentation	Clipboard Digital camera Drop camera Flashlight Mirror PPE
b	Diagram ventilation ducts			
c	Identify mechanical ventilation insulation type and condition			
d	Identify mechanical insulation coverage			
e	Visually inspect for leaks			
f	Identify ventilation registers			
g	Identify dampers			
h	Identify special use places requiring ventilation			
3	Assess Ventilation Controls			
a	Identify ventilation controls	Ventilation codes and standards	Calibration	Clipboard

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
b	Document ventilation controls settings/programming	Ventilation system controls	Documentation	Digital camera Flashlight Thermometer
c	Locate ventilation controls			
d	Evaluate calibration of ventilation controls			
4	Conduct Ventilation Performance Assessment			
a	Measure airflows	Diagnostic equipment Ventilation codes and standards	Documentation	Diagnostic tools Digital camera
b	Measure humidity levels			
c	Interview client about ventilation system performance			
d	Inspect for signs of moisture			
e	Verify that proper ventilation airflow pathways are unobstructed			
f	Measure static pressure			
5	Evaluate Ventilation Requirements			
a	Document occupant behavior impacting ventilation requirements	Ventilation codes and standards Ventilation rate analysis	Data interpretation Documentation Mathematics	Calculator
b	Identify which ventilation standards are applicable			
c	Review envelope leakage testing results			
d	Calculate required air exchange rates			
6	Identify Potential Hazard Sources			
a	Visually inspect for excessive moisture	Action levels for pollutant mitigation Air pollutant mitigation options	Carbon monoxide testing Observational	Diagnostic tools PPE
b	Visually inspect for mold			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
c	Visually inspect for air pollutants	Air pollutant sources Air pollutants		
d	Test for carbon monoxide from vehicles in the garage			
e	Visually inspect for improper storage of chemicals			
f	Verify that intakes for air supply are properly located away from pollutant sources			
g	Evaluate presence and condition of air filters			
7	Review Ventilation Operations and Maintenance Procedures			
a	Review ventilation O&M logs	Ventilation SOPs	Interviewing Verbal communication Research	
b	Review ventilation SOPs			
c	Interview maintenance staff			
G	Assessing Additional Loads and Sources			
1	Identify Additional Loads			
a	Locate additional loads and sources	Additional loads and sources Apartment end uses Co-generation Elevator system types Pools/spas Renewables	Documentation Observation	Diagnostic tools PPE
b	Evaluate condition of additional loads and sources			
c	Estimate energy consumption of each additional load/source			
d	Document energy intensity (including plug loads)			
e	Create schedule of loads and sources			
2	Identify Additional Water Loads			
a	Evaluate water supply system (e.g.,	Pumps	Data logging	Diagnostic tools

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
	pumps)	Water delivery system Water rate structures Water-efficient fixtures	Documentation	PPE
b	Inspect for leaks			
c	Interview building staff			
d	Interview residents			
e	Identify high consumption fixtures			
f	Assess need for water audit			
g	Review O&M procedures related to water loads			
3	Conduct Performance Assessment for Additional Loads and Sources			
a	Verify that additional loads and sources are functioning correctly	Additional loads and sources Apartment end uses Co-generation Elevator system types Pools/spas Renewables	Calculate energy consumption/production Data logging Mathematics	Diagnostic tools Ladder PPE
b	Verify that additional loads and sources are being used properly			
c	Perform energy consumption/production data logging			
d	Calculate energy consumption/production based on name plate data			
4	Evaluate Health and Safety Conditions for Additional Loads and Sources			
a	Identify unauthorized use of additional loads and sources	Additional loads and sources Apartment end uses Co-generation Elevator mechanical room safety Personal safety Renewables Safety codes and standards	Observational Documentation Interviewing Research	Diagnostic tools PPE
b	Identify fire and safety hazards			
c	Verify proper venting of additional loads and sources			
d	Inspect for gas leaks on additional loads			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
		Venting safety		
5	Assess Operations and Maintenance Procedures for Additional Loads and Sources			
a	Review O&M logs for additional loads and sources	SOPs for additional loads and sources	Interviewing Verbal communication Research	
b	Review SOPs for additional loads and sources			
c	Interview maintenance staff			
d	Interview residents			
e	Review incident reports			
H	Assessing Domestic Hot Water Systems			
1	Identify Domestic Hot Water Systems			
a	Conduct visual inspection of DHW system(s)	Building science Domestic hot water systems Fuel types	Documentation Sketching	Clipboard Diagnostic tools Schedule template System diagrams
b	Record name plate data			
c	Record age of DHW			
d	Evaluate DHW tank insulation			
e	Identify fuel source			
f	Photograph DHW system(s)			
g	Draw a mechanical room sketch			
h	Create DHW equipment schedule			
i	Visually inspect DHW equipment conditions			
j	Inspect for gas leaks			
2	Assess Domestic Hot Water Distribution System(S)			
a	Identify DHW distribution system type(s)	Causes of pipe failure Domestic hot water system	Documentation	Diagnostic tools

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
b	Identify DHW distribution system components	controls Leak control Piping types and fittings	Interviewing Observation	PPE
c	Evaluate DHW pipe insulation			
d	Inspect for water leaks			
e	Evaluate recirculation system			
f	Assess DHW system controls			
3	Evaluate health and safety conditions for domestic hot water system			
a	Identify burn/scald hazards	Asbestos identification Burn hazards Combustion safety testing and inspection protocols Fire hazards Legionella OSHA	Combustion safety testing	Diagnostic tools PPE
b	Inspect for mold			
c	Inspect functionality of pressure relief valve			
d	Verify maintenance of minimum storage temperature			
e	Inspect for gas leaks			
f	Identify potential asbestos-containing materials			
g	Perform combustion safety tests			
4	Evaluate health and safety conditions for domestic hot water system			
a	Identify burn/scald hazards	Asbestos identification Burn hazards Combustion safety testing and inspection protocols Fire hazards Legionella OSHA	Combustion safety testing	Diagnostic tools PPE
b	Inspect for mold			
c	Inspect functionality of pressure relief valve			
d	Verify maintenance of minimum storage temperature			
e	Inspect for gas leaks			
f	Identify potential asbestos-			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
	containing materials			
g	Perform combustion safety tests			
5	Conduct Domestic Hot Water System Performance Assessment			
a	Record supply temperature from source	Codes and regulations Combustion efficiency testing and inspections	Documentation Interviewing Mathematics	Diagnostic tools PPE
b	Record delivery temperature at fixture			
c	Test combustion efficiency of the appliance			
d	Record hot water delivery time			
e	Interview building staff about DHW system performance			
6	Measure Water Consumption			
a	Read water rate label from fixtures and appliances	Sampling protocols Water flow rates	Documentation Observation	Diagnostic tools Dye tablets PPE Stop watch
b	Determine water flow rates of fixtures			
c	Test toilets for leaks			
d	Perform water pressure drop test			
7	Review Domestic Hot Water Operations and Maintenance Procedures			
a	Review DHW O&M logs	Domestic hot water SOPs	Interviewing Verbal communication Research	
b	Review DHW SOPs			
c	Interview maintenance staff			
d	Interview residents			
e	Review incident reports			
I	Developing an Energy Performance Plan			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
1	Generate List of Energy Conservation Measures			
a	Analyze post site-visit data	Codes and standards Cost/benefit analysis Financial analysis Rebates and incentives ROI	Documentation Energy modeling Estimating Written communication Analysis	Calculator Computer Modeling software Spreadsheet software
b	Review existing conditions			
c	Perform energy modeling			
d	Assess upgrade/improvement opportunities			
e	Identify rebate and incentive opportunities			
f	Identify costs for recommended services			
g	Perform cost/benefit analysis			
h	Prioritize ECMs			
2	Generate List of Non- Energy Conservation Measures			
a	Analyze post site-visit data	Codes and standards Cost/benefit analysis Financial analysis Rebates and incentives	Documentation Estimating Written communication	Calculator Computer Spreadsheet software
b	Review existing conditions			
c	Assess upgrade/improvement opportunities			
d	Identify rebate and incentive opportunities			
e	Identify costs for recommended services			
f	Perform cost/benefit analysis			
g	Prioritize non-ECMs			
3	Create Energy Performance Plan Report			
a	Summarize existing building conditions	Benchmarking	Analytical	Computer

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
b	Summarize findings of energy audit	Building science Energy Modeling Energy Performance Plan Implementation ROI	Organizational Presentation Verbal communication Written communication	O&M templates Report template Word processing software
c	Summarize utility/fuel analysis			
d	Create final prioritized list of recommended measures			
e	Describe recommended measures			
f	Identify recommended sequence of construction			
g	Recommend materials and methods to stakeholders			
h	Present energy performance plan to stakeholders			
i	Provide O&M improvement recommendations			
J	Performing Post-Audit Activities			
1	Provide Owner Construction Assistance			
a	Create or review documents necessary for contractors to bid	Construction bidding Construction contracts and specifications Construction process Construction scheduling multifamily SWS	Analytical Evaluation Negotiation Organizational Planning Verbal communication	Energy performance plan multifamily SWS Spreadsheet software
b	Assist with creation of construction schedules			
c	Assist with construction oversight activities			
d	Review contractor submittals and change orders			
e	Provide clarification of recommended measures to stakeholders			
f	Provide technical assistance on recommended measures			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
2	Verification of Installed Measures			
a	Perform required performance testing on installed measures	Building science multifamily SWS	Diagnostic testing Documentation Energy modeling	Diagnostic tools Modeling software PPE multifamily SWS
b	Verify that installed measures meet specifications			
c	Finalize energy modeling with field testing data			
d	Document results of installed measure verification			
3	Complete Program Documentation			
a	Perform final utility/fuel analysis	Rebate and incentive programs	Documentation Written communication	Computer
b	Finalize rebate and incentive documentation			
c	Submit program documentation to agency			
4	Assist with Post-Retrofit Education			
a	Assist with creating O&M manuals	O&M practices Link between O&M practices and the effectiveness/outcomes of ECMs & non-ECMs	Training Verbal communication Written communication	O&M templates
b	Assist with resident O&M education			
c	Assist with building staff O&M education			

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Appendix C. Announcement of the Multifamily Job Task Analyses Validation Study

June 19, 2013

Professional Testing, Inc. and the National Renewable Energy Laboratory invite you to participate in a nationwide research study, validating the practices, characteristics, and activities of four multifamily building job categories. This is **your** opportunity to directly contribute to the development of the multifamily home energy upgrade workforce.

If you are a **practitioner** in one or more of the four multifamily building job categories listed below, please complete the corresponding study as soon as possible (by the end of June is preferable). Your participation should take approximately 20–30 minutes and individuals may complete more than one validation study, if applicable.

This validation study is the next step in developing Job Task Analyses (JTAs), which will help define the duties, tasks and skills needed to perform each of the jobs listed below.

- Multifamily Energy Auditor
- Multifamily Retrofit Project Manager
- Multifamily Building Operator
- Multifamily Quality Control Inspector

Please note: The above studies should only be completed by professionals who have actual job experience or who have trained those performing the job, **specifically for multifamily buildings**.

Your participation is voluntary and individual responses will be kept confidential. Your responses will be combined with those from other respondents and used to improve the job descriptions for the multifamily building energy upgrade workforce.

Additionally, we would greatly appreciate any help you could provide in sharing this request with other individuals and stakeholder groups who also participate in the specified multifamily job categories.

The comment period will remain open until July 19, 2013. You may direct any questions to workforce.guidelines@nrel.gov. Thank you in advance for your participation in this important process.

Sincerely,

The NREL Multifamily JTA Project Team

If you have any questions or comments about this email bulletin, please contact workforce.guidelines@nrel.gov.

Appendix D. Validation Study

Multifamily Energy Auditor JTA Validation Study

Welcome

Professional Testing and the National Renewable Energy Laboratory (NREL) are asking for your participation in an industry study critical to the profession of multifamily energy auditing. The goal of the study is to determine the essential tasks that describe the role of today's Multifamily Energy Auditors.

While Multifamily Energy Auditors work in a variety of settings and specialties, this study depends on your individual experience and opinion relating to your current role as a Multifamily Energy Auditor.

The study is divided into three sections:

Demographic information - The first step in completing this survey is to provide demographic information. The information you provide in this section will be used to ensure that a representative sample of responses is received, thus providing a better understanding of the variations that occur in performing the job of a Multifamily Energy Auditor.

Task ratings - The second section presents the tasks performed by Multifamily Energy Auditors. The tasks are organized into ten performance domains: Determining Scope of Energy Assessment; Preparing for Site Visit; Assessing Heating and Cooling System; Assessing Building Enclosure; Evaluating Lighting Conditions; Assessing IAQ and Ventilation System; Assessing Additional Loads and Sources; Assessing Domestic Hot Water Systems; Developing an Energy Performance Plan; and Performing Post-Audit Activities. You will be asked to rate each task on two scales: (1) the frequency of task performance and (2) the importance of the task to overall job performance.

Additional comments - A panel of subject matter experts (SMEs), representing diverse backgrounds, education, and work environment experiences in multifamily energy auditing, identified this list of important tasks. However, if after completing the study you feel that there are critical tasks that were not included, you will have an opportunity to identify additional tasks.

The definition of a multifamily building for purposes of this study is: any dwelling that contains living units, which share one or more building systems.

Your responses will be kept confidential, and we appreciate your participation. If you have any difficulty accessing or completing the study, please contact us at cowens@proftesting.com or call (800) 330-3776.

To begin, click on the Next button below.

Multifamily Energy Auditor JTA Validation Study

Demographics

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

What is the size of your organization?

- ◯ 1-10 people
- ◯ 11-50 people
- ◯ 51-500 people
- ◯ more than 500 people

In which state do you work?

In which sector do you currently work?

- ◯ Public (government at any level)
- ◯ Private

Which of the following jobs have you held in the multifamily (MF) building sector?

(Select all that apply)

- ☐ MF Energy Auditor
- ☐ MF Retrofit Project Manager
- ☐ MF Building Operator
- ☐ MF Quality Control Inspector
- ☐ Other (please specify)

Which of the following categories best describe your current position?

- ◯ MF Energy Auditor Inspection Practitioner
- ◯ MF Energy Auditor Inspection Curriculum Developer
- ◯ MF Energy Auditor Inspection Trainer/Proctor
- ◯ Other (please specify)

Multifamily Energy Auditor JTA Validation Study

How many years of experience have you had working as a Multifamily Energy Auditor (total combined years)?

- ◯ None
- ◯ 5 Years or Less
- ◯ 6-10 Years
- ◯ 11-15 Years
- ◯ 16-20 Years
- ◯ More than 20 Years

How many years of total experience do you have in the multifamily building industry (all jobs)?

- ◯ None
- ◯ 5 Years or Less
- ◯ 6-10 Years
- ◯ 11-15 Years
- ◯ 16-20 Years
- ◯ More than 20 Years

What is your highest completed level of education?

- ◯ Some High School
- ◯ High School
- ◯ Some College
- ◯ Technical/Vocational School
- ◯ Bachelor's Degree
- ◯ Graduate Degree

To what professional societies/organizations do you belong?

(Select all that apply)

- [ ] None
- [ ] AABC Commissioning Group (ACG)
- [ ] American Institute of Architects (AIA)
- [ ] American Society of Civil Engineers (ASCE)
- [ ] American Society of Mechanical Engineers (ASME)
- [ ] American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- [ ] APPA
- [ ] Association for the Advancement of Cost Engineering (AACE)
- [ ] Association for Facilities Engineering
- [ ] Association of Energy Engineers (AEE)
- [ ] Building Commissioning Association (BCA)
- [ ] Building Owners and Managers Association (BOMA)
- [ ] Construction Specifications Institute (CSI)
- [ ] International Association of Plumbing and Mechanical Officials (IAPMO)
- [ ] International Building Performance Simulation Association (IBPSA)
- [ ] International Code Council (ICC)
- [ ] International Facility Management Association (IFMA)
- [ ] International Union of Operating Engineers (IUOE)
- [ ] Institute of Electrical and Electronics Engineers (IEEE)
- [ ] Laborers' International Union of North America (LIUNA)
- [ ] National Fire Protection Association (NFPA)
- [ ] National Institute of Building Sciences (NIBS)
- [ ] Service Employees International Union
- [ ] Sheet Metal Workers' International Association (SMWIA)
- [ ] United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (UA)
- [ ] United Brotherhood of Carpenters
- [ ] United Steelworkers (USW)
- [ ] U.S. Green Building Council (USGBC)
- [ ] Other (please specify)

What building performance credentials do you currently hold?

(Select all that apply)

- [ ] None
- [ ] AABC Commissioning Group Certified Commissioning Authority (CxA)
- [ ] AABC Commissioning Group Certified Commissioning Technician (CxT)
- [ ] American Society of Heating, Refrigerating and Air-Conditioning Engineers Building Energy Modeling Professional (BEMP)
- [ ] American Society of Heating, Refrigerating and Air-Conditioning Engineers Commissioning Process Management Professional (CPMP)
- [ ] American Society of Heating, Refrigerating and Air-Conditioning Engineers Operations and Performance Management Professional (OPMP)
- [ ] Association for Facilities Engineering Certified Plant Engineer (CPE)
- [ ] Association for Facilities Engineering Certified Plant Maintenance Manager (CPMM)
- [ ] Association for Facilities Engineering Certified Plant Supervisor
- [ ] Association of Energy Engineers Certified Building Energy Simulation Analyst (BESA)
- [ ] Association of Energy Engineers Certified Building Commissioning Professional (CBCP)
- [ ] Association of Energy Engineers Certified Energy Auditor (CEA)
- [ ] Association of Energy Engineers Certified Energy Manager (CEM)
- [ ] Association of Energy Engineers Existing Building Commissioning Professional (EBCP)
- [ ] Association of Energy Engineers Energy Manager in Training (EMIT)
- [ ] Association of Energy Engineers/Efficiency Valuation Organization Certified Measurement and Verification Professional
- [ ] BOMI International Facilities Management Administrator (FMA)
- [ ] BOMI International Real Property Administrator (RPA)
- [ ] BOMI International Systems Maintenance Administrator (SMA)
- [ ] BOMI International Systems Maintenance Technician (SMT)
- [ ] BPI Energy Auditor
- [ ] BPI Retrofit Installer
- [ ] BPI Crew Leader
- [ ] BPI Quality Control Inspector
- [ ] BPI Building Analyst
- [ ] BPI Envelope Professional
- [ ] BPI Residential Building Envelope Whole House Air Leakage Control Installer
- [ ]

- [ ] BPI Manufactured Housing Professional
- [ ] BPI Heating Professional
- [ ] BPI Air Condiditioned Heat Pump Professional
- [ ] BPI Multifamily Professional
- [ ] Building Commissioning Association Certified Commissioning Professional (CCP)
- [ ] Building Operator Certification – Level I (BOC Level I)
- [ ] Building Operator Certification – Level II (BOC Level II)
- [ ] The City University of New York Energy Management and Indoor Air Quality Certification
- [ ] Energy Audit Institute Commercial Energy Audit Certification
- [ ] General Professional Accreditations Licensed Architect
- [ ] General Professional Accreditations Professional Engineer (PE)
- [ ] International Facility Management Association Facility Management Professional (FMP)
- [ ] International Facility Management Association Certified Facility Manager (CFM)
- [ ] National Energy and Sustainability Institute Commercial Energy Auditor Certification
- [ ] National Environmental Balancing Bureau Building Systems Commissioning Certified Professional
- [ ] National Environmental Balancing Bureau Retro Commissioning Certified Professional
- [ ] Northwest Energy Education Institute Energy Management Certification (EMC)
- [ ] Testing, Adjusting, and Balancing Bureau Certified Commissioning Contractor (CCC)
- [ ] Testing, Adjusting, and Balancing Bureau Certified Commissioning Supervisor (CCS)
- [ ] University of California, Davis Professional Certification in Energy Resource Management
- [ ] The University of Wisconsin, Madison Commissioning Process Certification
- [ ] U.S. Green Building Council LEED AP BD+C
- [ ] U.S. Green Building Council LEED AP Homes
- [ ] U.S. Green Building Council LEED AP ID+C
- [ ] U.S. Green Building Council LEED AP ND
- [ ] U.S. Green Building Council LEED AP O+M
- [ ] U.S. Green Building Council LEED Green Associate
- [ ] Other (please specify accreditation and conferring organization)

Multifamily Energy Auditor JTA Validation Study

How did you hear about this study?

- ◯ Listserve
- ◯ Direct email invitation
- ◯ Received forwarded invitation from a colleague
- ◯ BLOG
- ◯ Website
- ◯ Other (please specify)

Multifamily Energy Auditor JTA Validation Study

Task Ratings

Below is a list of tasks performed by **Multifamily Building Energy Auditors**.

The tasks are organized into ten performance domains: Determining Scope of Energy Assessment; Preparing for Site Visit; Assessing Heating and Cooling System; Assessing Building Enclosure; Evaluating Lighting Conditions; Assessing IAQ and Ventilation System; Assessing Additional Loads and Sources; Assessing Domestic Hot Water Systems; Developing an Energy Performance Plan; and Performing Post-Audit Activities.

In this section you will rate each task on two dimensions – *Frequency* and *Importance* – according to the rating scales below:

FREQUENCY - Rate each task statement based on the average frequency that you perform the task:

Never perform
Occasionally perform
Perform fairly often
Perform very often

IMPORTANCE - Rate each task statement based on how important the task is to the performance of the job:

Not important
Somewhat important
Important
Very important

(To answer, use your mouse to click the down arrow to reveal a set of options. Then select an option for both Frequency and Importance. To change your selection, click on another option in the drop down menu.)

Determining Scope of Energy Assessment:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Interview client to determine objectives		
Collect scoping data		
Determine feasibility of audit scope		
Establish scope of services		

Preparing for Site Visit:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Review building plans		
Perform utility bill analysis		
Perform site visit planning		

Assessing Heating and Cooling System:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Identify heating and cooling systems		
Assess heating and cooling distribution system		
Assess heating and cooling controls		
Assess heat-related health and safety conditions		
Assess cooling-related health and safety conditions		
Conduct heating and cooling system performance evaluation		
Review heating and cooling O&M procedures		

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Task Ratings

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Assessing Building Enclosure:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Assess wall assembly		
Assess roof and attic assembly		
Assess window and door types		
Assess foundation and floor system condition		
Test envelope infiltration		
Evaluate enclosure health and safety conditions		
Review enclosure O&M procedures		

Evaluating Lighting Conditions:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Identify lighting system types		
Assess lighting controls		
Conduct lighting performance assessment		
Evaluate lighting health and safety conditions		
Review lighting O&M procedures		

Assessing IAQ and Ventilation System:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Assess type of ventilation system		
Assess ventilation distribution system		
Assess ventilation controls		
Conduct ventilation performance assessment		
Evaluate ventilation requirements		
Identify potential hazard sources		
Review ventilation O&M procedures		

Multifamily Energy Auditor JTA Validation Study

Task Ratings

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The tasks are organized into ten performance domains: Determining Scope of Energy Assessment; Preparing for Site Visit; Assessing Heating and Cooling System; Assessing Building Enclosure; Evaluating Lighting Conditions; Assessing IAQ and Ventilation System; Assessing Additional Loads and Sources; Assessing Domestic Hot Water Systems; Developing an Energy Performance Plan; and Performing Post-Audit Activities.

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Perform very often

IMPORTANCE - Rate each task statement based on how important the task is to the performance of the job:

Not important
Somewhat important
Important
Very important

(To answer, use your mouse to click the down arrow to reveal a set of options. Then select an option for both Frequency and Importance. To change your selection, click on another option in the drop down menu.)

Assessing Additional Loads and Sources:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Identify additional loads		
Identify additional water loads		
Conduct performance assessment for additional loads and sources		
Evaluate health and safety conditions for additional loads and sources		
Assess O&M procedures for additional loads and sources		

Assessing Domestic Hot Water Systems:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Identify domestic hot water systems		
Assess domestic hot water distribution system(s)		
Evaluate health and safety conditions for domestic hot water system		
Conduct domestic hot water system performance assessment		
Measure water consumption		
Review domestic hot water O&M procedures		

Developing an Energy Performance Plan:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Generate list of energy conservation measures		
Generate list of non-energy conservation measures		
Create Energy Performance Plan report		

Performing Post-Audit Activities:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Provide owner construction assistance		
Verification of installed measures		
Complete programmatic documentation		
Assist with Post-Retrofit Education		

Multifamily Energy Auditor JTA Validation Study

Additional Comments

Are there any tasks that are missing from this survey?

- ◯ No
- ◯ Yes

If yes, what?

Would you like to provide any additional comments?

- ◯ No
- ◯ Yes

If yes, what?

Multifamily Energy Auditor JTA Validation Study

Thank you!

You have completed the study. Professional Testing, Inc. and NREL would like to thank you for taking the time to participate in the Multifamily Energy Auditor JTA development process.

If you have any questions about the Multifamily JTA Project, please contact NREL at workforce.guidelines@nrel.gov.