

## INVITATION TO SUBMIT A RESEARCH PROPOSAL ON AN ASHRAE RESEARCH PROJECT

### 1836-TRP, “Developing a Standardized Categorization System for Energy Efficiency Measures”

Attached is a Request-for-Proposal (RFP) for a project dealing with a subject in which you, or your institution have expressed interest. Should you decide not to submit a proposal, please circulate it to any colleague who might have interest in this subject.

Sponsoring Committee: TC 7.6, Building Energy Performance  
Co-sponsored by: BEQ & SSPC 100, Energy Efficiency in Existing Buildings

Budget Range: \$180,000 may be more or less as determined by value of proposal and competing proposals.

Scheduled Project Start Date: **TBD** or later.

**All proposals must be received at ASHRAE Headquarters by 8:00 AM, EST, **TBD**. NO EXCEPTIONS, NO EXTENSIONS. Electronic copies must be sent to [rpbids@ashrae.org](mailto:rpbids@ashrae.org). Electronic signatures must be scanned and added to the file before submitting. The submission title line should read: 1836-TRP, “Developing a Standardized Categorization System for Energy Efficiency Measures” and “*Bidding Institutions Name*” (electronic pdf format, ASHRAE’s server will accept up to 10MB)**

If you have questions concerning the Project, we suggest you contact one of the individuals listed below:

#### For Technical Matters

Technical Contact  
Robert Hitchcock  
480 Stockman Ln  
Lincoln, CA 95648-8378  
Phone: 530-651-4425  
E-Mail: [rjhitchcock@gmail.com](mailto:rjhitchcock@gmail.com)

#### For Administrative or Procedural Matters:

Manager of Research & Technical Services (MORTS)  
Michael R. Vaughn  
ASHRAE, Inc.  
1791 Tullie Circle, NE  
Atlanta, GA 30329  
Phone: 404-636-8400  
Fax: 678-539-2111  
E-Mail: [MORTS@ashrae.net](mailto:MORTS@ashrae.net)

**Contractors intending to submit a proposal should so notify, by mail or e-mail, the Manager of Research and Technical Services, (MORTS) by **TBD** in order that any late or additional information on the RFP may be furnished to them prior to the bid due date.**

All proposals must be submitted electronically. Electronic submissions require a PDF file containing the complete proposal preceded by signed copies of the two forms listed below in the order listed below. **ALL electronic proposals are to be sent to [rpbids@ashrae.org](mailto:rpbids@ashrae.org).**

**All other correspondence must be sent to [ddaniel@ashrae.org](mailto:ddaniel@ashrae.org) and [mvaughn@ashrae.org](mailto:mvaughn@ashrae.org). Hardcopy submissions are not permitted. In all cases, the proposal must be submitted to ASHRAE by 8:00 AM, EST, **TBD**. NO EXCEPTIONS, NO EXTENSIONS.**

The following forms (Application for Grant of Funds and the Additional Information form have been combined) must accompany the proposal:

- (1) ASHRAE Application for Grant of Funds (electronic signature required) and
- (2) Additional Information for Contractors (electronic signature required) ASHRAE Application for Grant of Funds (signed) and

**ASHRAE reserves the right to reject any or all bids.**

### **State of the Art (Background)**

The existing building stock presents significant potential to conserve energy while maintaining desired occupant comfort and building performance. Many public and private sector programs have been, and continue to be undertaken to address this issue, and countless professional firms operate within an energy audit and conservation community. Whole building and deep retrofit Utility incentive programs often resort to ‘custom’ approaches for characterizing the descriptions of common energy efficiency measures (EEMs) (also referred to as energy conservation measures – ECMs), which then carry additional review and administrative costs, putting pressure on overall program cost-effectiveness. Efforts to effectively and accurately analyze and quantify these savings at the program, regional, or national level have been limited by the lack of standardized categorization of EEMs. Projects tend to be unique to each building, with little standardization of EEMs. A standardized categorization system, with a clear definition of identification, funding, approval, and implementation process is needed.

Numerous efforts over several decades have developed lists of EEMs for specific programs and purposes from 1980’s US DOE Institutional Conservation Program (USDOEa, 2017) and IEA ECBCS Energy Auditing Annex 11 (IEA, 1987), to current efforts including the DOE sponsored BuildingSync, intended as a standardized language for commercial building energy audit data, the DOE Asset Score Reporting Platform (USDOEb, 2017), NREL Building Component Library (NREL, 2017), LBNL CBES web tool (LBNL, 2017), and ASHRAE Standards 100 (ASHRAE, 2015), 211 (ASHRAE, 2018), NREL’s Residential Measures Database (NREL, 2018) and ASHRAE’s BuildingEQ. Each of these efforts have developed different lists of substantially similar sets of EEMs. This has served the purpose of standardizing measures within individual programs, but not across programs.

There is a significant need for such standardization. Several cities now have energy audit ordinances or are considering one. With cities developing their own reporting mechanisms, having standard nomenclature and classification for EEMs would allow for greater transparency, understanding of opportunities within buildings and the overall stock, and evaluation of program success through energy savings achieved and successful energy efficiency measures. Moreover, clear comparison of the EEMs addressed by the various programs will be aided by such a characterization, whereas now the scope and comparison of individual EEMs suffers from confusion and incomplete data.

### **Justification and Value to ASHRAE**

ASHRAE has published two Standards that include energy audit requirements (Standard 211-2018) or a list of EEMs (Standard 100-2015), as well as a Special Publication that prescribes Procedures for Commercial Building Energy Audits. Depending on the outcomes of this RP, the results would likely be included in those Standards, and perhaps the work may even lead to development of a new Standard or Guideline that would codify the findings of the research.

A core component of ASHRAE’s Building EQ is the actional recommendations derived from a list of EEM’s. The results of this project would enhance the value of the database of information contained in the Building EQ Portal.

This research will expand ASHRAE’s leadership role in defining energy audits and the details/specifications for the types of measures, and framework for reporting, for the broader energy efficiency industry, and would likely be referenced or adopted for use over time by a range of levels of government (beginning with some leading US cities that already reference ASHRAE Audit procedures), utilities and others that support and or pay for energy audits, and others.

### **Objectives**

The objective of this project is to develop a standardized system for the characterization and categorization of EEMs so that all parties involved in a building efficiency project can share a common nomenclature and understanding of each EEM, as well as a system of organization which can be utilized to drive a project and enhance project communication.

The categorization shall be specific enough to clearly characterize individual measures and support aggregated analysis of multiple measures by systems, actions, end-uses, costs and benefits.

In order to achieve these goals, the categorization shall:

- address all residential and commercial building systems including: envelope, lighting, controls, HVAC distribution and equipment, plug loads, water heating and distribution, refrigeration, and electrical distribution
- identify different levels of measure abstraction to be suggested by the contractor, such as measurement boundaries (whole building or base building), or specific individual systems;
- consist of a hierarchy which is flexible enough to capture major EEM variations and nuances, while simple enough to be commonly understood;
- include EEM level descriptions such that each EEM is clearly defined in both scope and intent;
- be comprehensive enough to be applicable to all common building and climate types;
- allow for future development as technologies, policies and economics evolve;
- be organized in a way that assists in the identification and justification of EEMs;
- complement the existing related literature and standards in service of industry-wide acceptance;
- be written with all major stakeholders as its intended audience, included but not limited to: engineers, architects, program/incentive administrators, compliance agencies, project financiers, data scientists, building operators, and building owners;
- include a data structure suited for aggregated project analysis such as measure and program effectiveness.

**Scope:**

The approach to this project should aim for simplicity in categorizing EEMs. A distinction should be made between categorization and characterization. Categorization is the primary objective and supports organization of any and all EEMs into a classification taxonomy/hierarchy. Characterization should be a secondary objective that would support analysis of a dataset of EEMs by providing properties that should be captured for an individual EEM. Examples of categorization factors include: building system, subsystem, technology component, and action. Examples of characterization factors include climate zone, building type, cost, savings, and payback.

1. Task 1: Literature review of previous standards/programs that have developed lists of EEMs and systems to categorize them.
  - a. Objective: A literature review will be carried out at the start of the project to identify various utility incentive programs, energy efficiency programs and audit ordinances that have developed lists of EEMs and systems to describe them. This will help identify a comprehensive list of measures as well as various approaches to organizing, categorizing, and characterizing measures.
  - b. Approach: Numerous efforts over several decades have developed lists of EEMs for specific programs and purposes. Each of these efforts has developed different lists of substantially similar sets of EEMs. These sources would provide a good starting point for identifying the categorization methods and EEMs used.  
In addition to efforts that have developed a list of EEMs, the literature review should also look into existing energy efficiency programs that define a categorization system or methodology for aggregation of savings.
  - c. Deliverables/Schedule: An interim report summarizing reviewed programs. The report should identify categorization systems adopted by programs and the features of each system which could inform the development of the standard categorization system. A comprehensive EEM list should also be developed based on all programs. Characteristics of EEMs captured for evaluation should also be documented.
2. Task 2: Identify categorization factors that should be used for a standard classification system and develop a hierarchical categorization system capable of accommodating the reviewed standards/programs and the varying categorization approaches used in each.
  - a. Objective: Using the outcomes of Task 1, the objective of this task would be to identify an overarching set of categorization factors used in the reviewed programs and develop a system capable of organizing the full list of EEMs. In essence, this would be a hierarchical naming convention for EEMs.
  - b. Approach: The developed categorization system should include the following capabilities:
    - identify different levels of measure abstraction
    - consist of a hierarchy which is flexible enough to capture major EEM variations and nuances, while simple enough to be commonly understood
    - be comprehensive enough to be applicable to all common building and climate types

- allow for future development as technologies, policies and economics evolve
    - complement the existing related literature and standards in service of industry-wide acceptance
  - c. Deliverable/Schedule: An interim report summarizing the proposed hierarchical categorization system.
- 3. Task 3: Identify characterization properties to be captured for any given EEM.
  - a. Objective: The first objective is to develop a common set of project properties that should be captured for each EEM instance to support filtering and analysis of an actual dataset of EEMs. Examples of such properties may include climate zone, building type, cost, savings, and payback. A second objective is to develop and define a common set of EEM properties such that any given EEM can be consistently interpreted, for example, a property that must be included is a concise text definition of each EEM.
  - b. Approach: Identify and define project properties that need to be captured to usefully characterize an EEM for analysis. Provide example values for each property for at least 5 example projects. Identify the level of EEM definition necessary for consistent understanding of all EEMs included in the list and define each EEM accordingly. Identify how the EEM effectiveness might be validated through Monitoring and Verification (e.g., deemed vs. measured savings; calculated vs. estimated; etc.)
  - c. Deliverable/Schedule: An interim report summarizing the project and EEM characterization properties, the example set of project characterization values, and the fully defined EEM characterizations.
- 4. Task 4: Harmonize the inconsistencies between the various programs to develop an example set of EEMs within the developed categorization system
  - a. Objective: The objective of this task is to assure that the variety of EEMs listed under each of the programs studied in Task 1 are capable of being categorized within the proposed system.
  - b. Approach: Referring to the various programs studied in Task 1, harmonize each program's list of EEMs so that they fit within the proposed categorization system.
  - c. Deliverable/Schedule: An interim report documenting the categorization hierarchy containing EEMs from Task 1 programs.
- 5. Task 5. Draft of final research report
  - a. Objective: A written report in a form approved by the Society shall be prepared combining the interim reports delivered for Tasks 1-4.
- 6. Task 7. Final Report

**Deliverables:**

Progress, Financial and Final Reports, Technical Paper(s), and Data shall constitute the deliverables ("Deliverables") under this Agreement and shall be provided as follows:

- a. Progress and Financial Reports

Progress and Financial Reports, in a form approved by the Society, shall be made to the Society through its Manager of Research and Technical Services at quarterly intervals; specifically on or before each January 1, April 1, June 10, and October 1 of the contract period.

The interim reports specified in Tasks 1 through 4 shall be delivered on the schedule specified in the proposal.

Furthermore, the Institution's Principal Investigator, subject to the Society's approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring Technical Committee/Task Group (TC/TG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. Final Report

A written report, design guide, or manual, (collectively, "Final Report"), in a form approved by the Society, shall be prepared by the Institution and submitted to the Society's Manager of Research and Technical Services by the end of the Agreement term, containing complete details of all research carried out under this Agreement, including a summary of the control strategy and savings guidelines. Unless otherwise specified, the final draft report shall be furnished, electronically for review by the Society's Project Monitoring Subcommittee (PMS).

Tabulated values for all measurements shall be provided as an appendix to the final report (for measurements which are adjusted by correction factors, also tabulate the corrected results and clearly show the method used for correction).

Following approval by the PMS and the TC/TG, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:

- An executive summary in a form suitable for wide distribution to the industry and to the public.
- Two copies; one in PDF format and one in Microsoft Word.

c. *Science & Technology for the Built Environment* or ASHRAE Transactions Technical Papers

One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (MORTS) and then to the "ASHRAE Manuscript Central" website-based manuscript review system in a form and containing such information as designated by the Society suitable for publication. Papers specified as deliverables should be submitted as either Research Papers for HVAC&R Research or Technical Paper(s) for ASHRAE Transactions. Research papers contain generalized results of long-term archival value, whereas technical papers are appropriate for applied research of shorter-term value, ASHRAE Conference papers are not acceptable as deliverables from ASHRAE research projects. The paper(s) shall conform to the instructions posted in "Manuscript Central" for an ASHRAE Transactions Technical or HVAC&R Research papers. The paper title shall contain the research project number (1836-RP) at the end of the title in parentheses, e.g., (1836-RP).

All papers or articles prepared in connection with an ASHRAE research project, which are being submitted for inclusion in any ASHRAE publication, shall be submitted through the Manager of Research and Technical Services first and not to the publication's editor or Program Committee.

Note: A research or technical paper describing the research project must be submitted after the sponsoring committee has approved the Final Report. Research or technical papers may also be prepared before the project's completion, if it is desired to disseminate interim results of the project.

Contractor shall submit any interim papers to MORTS and the PMS for review and approval before the papers are submitted to ASHRAE Manuscript Central for review.

d. Data

Data is defined in General Condition VI, "DATA"

e. Project Synopsis

A written synopsis totaling approximately 100 words in length and written for a broad technical audience, which documents 1. Main findings of research project, 2. Why findings are significant, and 3. How the findings benefit ASHRAE membership and/or society in general shall be submitted to the Manager of Research and Technical Services by the end of the Agreement term for publication in ASHRAE Insights

The Society may request the Institution submit a technical article suitable for publication in the Society's ASHRAE JOURNAL. This is considered a voluntary submission and not a Deliverable. Technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

### **Level of Effort**

The anticipated level of effort is approximately 10 person months (2 for the PI, and 8 for other professionals and research assistants) with a total cost of \$80,000. The project is expected to take approximately 14 to 16 months, beginning with a launch meeting at the Winter or Annual ASHRAE meeting to have an in-person initial project meeting, an in-person mid-project review, and presentation of draft final results one year after the project launch. It is expected that the largest effort will be the work for Task 2. The progress payment schedule will be contingent on delivery of the project milestones as outlined below.

### **Project Milestones:**

<b>No.</b>	<b>Major Project Completion Milestone</b>	<b>Deadline Month</b>
1	Interim report summarizing Literature Review	2
2	Interim report summarizing suggested hierarchical categorization system	4
3	Interim report summarizing the characterization variables and the example sets of values for selected EEMs	5
4	Interim report documenting the categorization hierarchy containing EEMs from Task 1 programs	8
5	Draft Final Report	11
6	Approved Final Report	14

### **Proposal Evaluation Criteria**

<b>No.</b>	<b>Proposal Review Criterion</b>	<b>Weighting Factor</b>
1.	Contractor's understanding of the Work Statement as revealed in the proposal	20%
2.	Relevant qualifications and experience of the personnel who will conduct this project	30%
3.	Quality of methodology proposed for conducting research and probability that the contractor's research plan will meet the objectives of the Work Statement	50%

### **References**

1. ASHRAE Building Energy Quotient (Building EQ): see <http://buildingenergyquotient.org/> (accessed 2018)
2. ASHRAE Procedures for Commercial Building Energy Audits, Second Edition (2011)
3. ASHRAE Standard 100-2015: Energy Efficiency in Existing Buildings - Informative Annex E: Energy Efficiency Measures (and related list of "Operations and Maintenance Requirements for Building Systems and Elements, Informative Annex D)
4. ASHRAE Standard 211-2018: Standard for Commercial Building Energy Audits
5. Building Sync measure list: see <https://buildingsync.net/documents/measures/>
6. International Energy Agency ECBCS Annex 11, Source Book for Energy Auditors, April 1987: Annotated List of Energy Conservation Opportunities (in Volume 2, Appendix D); [http://www.iea-ebc.org/Data/publications/EBC\\_Annex\\_11\\_source\\_book\\_vol2.pdf](http://www.iea-ebc.org/Data/publications/EBC_Annex_11_source_book_vol2.pdf)
7. Lawrence Berkeley National Lab Commercial Building Energy Saver: see <http://cbes.lbl.gov/buildings>
8. List of Jurisdictions with Mandatory Energy Audit Requirements:
9. <https://www.buildingrating.org/graphic/us-commercial-building-policy-comparison-matrix>
10. NREL 2017, Building Component Library <https://bcl.nrel.gov/>
11. NREL 2018, Residential Measures Database <https://remdb.nrel.gov/>
12. Technical Reference Manuals Best Practices from Across the Nation to Inform the Creation of the California Electronic Technical Reference Manual (eTRM): [https://aceee.org/files/proceedings/2016/data/papers/6\\_1027.pdf](https://aceee.org/files/proceedings/2016/data/papers/6_1027.pdf)
13. Washington State University Energy Audit Workbook, 2003: <http://www.energy.wsu.edu/Documents/audit2.pdf>