[6450-01-P]

DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy

[Docket Number EERE-2015-BT-BC-0001]

Request for Information: Updating and Improving the DOE Methodology for Assessing the Cost-effectiveness of Building Energy Codes

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy

ACTION: Request for Information.

SUMMARY: The U.S. Department of Energy (DOE) is seeking input on how it may update and improve its methodology for assessing the cost-effectiveness (which includes an energy savings assessment) of residential and commercial building energy codes. DOE is directed by statute to provide technical assistance to states to support the implementation of model building energy codes. As part of this role, DOE conducts national and state-level analysis to assess the cost-effectiveness of building energy codes and proposed changes. DOE is interested in feedback on its analysis methodology, preferred sources of cost data, and parameter assumptions surrounding its cost-effectiveness assessment. In addition, DOE is seeking information on the general costs, benefits, and economic impacts associated with building energy codes. This notice identifies several areas where interested parties may provide suggestions, comments, and other information.

DATES: Written comments and information are requested by **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**

ADDRESSES: Comments must identify the docket number **EERE-2015-BT-BC-0001** and may be submitted using any of the following methods:

1. *Regulations.gov*: http://www.regulations.gov/#!docketDetail;D=EERE-2015-BT-BC-0001. Follow the instructions for submitting comments.
2. *Email*: BCMethodology2015BC0001@ee.doe.gov. Include EERE-2015-BT-BC-0001 in the subject line of the message.
3. *Postal Mail*: Ms. Brenda Edwards; U.S. Department of Energy, Building Technologies Office EE-5B, 1000 Independence Avenue SW, Washington, DC 20585; Phone: (202) 586-2945. Please submit one signed paper original.

Further instructions, including the use of topic identifiers, are provided in the *Public Participation* section of this notice. Comments submitted in response to this notice will become a matter of public records and will be made publicly available.

Public Docket: The docket, which includes notices published in the *Federal Register* and public comments received, is available for review at Regulations.gov. All documents in the docket are listed in the Regulations.gov index. However, some documents listed in the index, such as those containing information exempt from public disclosure, may not be publicly available.

A link to the docket web page can be found under *Public Participation* at: http://www.energycodes.gov/events. This web page will also contain a link to the docket for this notice on Regulations.gov. The Regulations.gov site will contain instructions on how to access all documents, including public comments, in the docket.

For further information on how to submit a comment, review comments received, or otherwise participate in the public comment process, contact Ms. Brenda Edwards by phone at (202) 586-2945 or email: Brenda.Edwards@ee.doe.gov.

FOR FURTHER INFORMATION CONTACT:

Jeremiah Williams; U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office EE-5B, 1000 Independence Avenue SW, Washington, DC 20585; Phone: (202) 287-1941, E-mail: jeremiah.williams@ee.doe.gov.

For legal matters, contact: Kavita Vaidyanathan; U.S. Department of Energy, Office of the General Counsel, Forrestal Building, Mailstop GC-33, 1000 Independence Ave SW, Washington, DC 20585; Phone: (202) 586-0669, E-mail: kavita.vaidyanathan@hq.doe.gov.

SUPPLEMENTARY INFORMATION:

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I. Authority and Background

Section 307(b) of the Energy Conservation and Production Act (ECPA, Public Law 102-486), as amended, directs DOE to support voluntary building energy codes by periodically reviewing the technical and economic basis of the voluntary building energy codes and to "seek adoption of all technologically feasible and economically justified energy efficiency measures; and…otherwise participate in any industry process for review and modification of such codes" (42 U.S.C. 6836(b)(2) and (3)). DOE participates in the development of the International Energy Conservation Code (IECC), maintained by the International Code Council (ICC) for residential and commercial buildings, and in the development of Standard 90.1, maintained by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for commercial buildings.

This Request for Information (RFI) seeks public input on revisions to DOE's established methodologies for assessing the cost-effectiveness of proposed changes to residential and commercial building energy codes and new editions of such codes. DOE has previously expressed interest in receiving information surrounding the costs and benefits associated with building energy codes (August 6, 2013, 78 FR 47677 and May 15, 2014, 79 FR 27778). The current request for information will ensure that DOE is able to maintain appropriate means of evaluating the cost-effectiveness of building energy codes, including the selection of appropriate data sources and methods to analyze the economic impacts associated with code updates. This notice is intended to communicate relevant updates to the general public and solicit feedback on the specific analysis parameters subject to revision. In addition, this request provides a broader opportunity for input on DOE's designated methods. DOE uses

these methodologies to inform its participation in the update processes of the IECC, ASHRAE Standard 90.1, and other building energy codes—both in developing proposals and in assessing the proposals of others, when necessary. DOE also uses these methodologies in assessing the cost-effectiveness of new code editions. DOE evaluates energy codes and code proposals based on life-cycle cost analysis, accounting for energy savings, incremental investment for energy efficiency measures, and other economic impacts.

The value of future savings and costs are discounted to a present value, with improvements deemed cost-effective when the net savings is positive. Assessing the cost-effectiveness of a proposed code change or a newly revised code involves *three primary steps*:

1. estimating the *energy savings* of the changed code provision(s),
2. estimating the *first cost* of the changed provision(s), and
3. calculating the corresponding *economic impacts* of the changed provision(s).

These steps are detailed in the established residential and commercial methodologies, as referenced later in this RFI (see the *Analysis of Residential Buildings* and *Analysis of Commercial Buildings* sections of this notice). The DOE methodologies for residential and commercial buildings have the same life-cycle cost basis and parallel one another closely. However, because there is variation in the economic criteria associated with different types of commercial building ownership, up to *three scenarios* may be used for commercial cost-effective analysis:

- **Scenario 1** (also referred to as the *Publicly-Owned Method*): Life-cycle cost analysis method representing government or public ownership (without borrowing or taxes).
- **Scenario 2**: (also referred to as the *Privately-Owned Method*): Life-cycle cost analysis method representing private or business ownership (includes loan and tax impacts).
- **Scenario 3**: (also referred to as the *ASHRAE 90.1 Scalar Method*[1]): Represents a pre-tax private investment point of view, and uses economic inputs established by the ASHRAE 90.1 Standing Standard Project Committee (SSPC).

For the commercial methodology DOE is seeking public input only on the method and sources for parameters of Scenario 2, as the method and parameters for Scenario 1 are established by federal regulation, and the method and parameters for Scenario 3 are established by the ASHRAE 90.1 SSPC. DOE intends to continue to rely on Scenarios 1 and 3 since they are required for federal projects and addenda to ASHRAE Standard 90.1, respectively.

In preparation for this RFI, DOE reviewed the established residential and commercial methodologies and is proposing revisions. These revisions are limited to minor clarifications and attempts to streamline certain portions; the overall methodology remains unchanged in terms of procedure and content. For brevity, only the proposed revisions to the methodologies are discussed here; the entire residential

[1] McBride M.F., "Development of Economic Scalar Ratios for ASHRAE Standard 90.1 R," in Proceedings of Thermal Performance of the Exterior Envelopes of Buildings VI, ASHRAE (presented at the Thermal Performance of the Exterior Envelopes of Buildings VI, ASHRAE, 1995), http://consensus.fsu.edu/FBC/2010-Florida-Energy-Code/901_Scalar_Ratio_Development.pdf.

methodology and commercial methodology are available for review, as referenced below (see *Analysis for Residential Buildings* and *Analysis for Commercial Buildings* sections of this notice) and are not published in full within the current RFI.

II. Analysis of Residential Buildings

The focus of this section of the RFI is residential buildings, which DOE defines in a manner consistent with the IECC—one- and two-family dwellings, townhouses, and low-rise (three stories or less above grade) multifamily residential buildings. DOE previously established a methodology for assessing the cost-effectiveness of changes made to the residential building energy code through an RFI process published in the *Federal Register* on September 13, 2011 (76 FR 56413). DOE took into consideration the information it received during the public comment period, and published the final methodology in 2012.[2] This methodology, hereafter referred to as the "established residential methodology," was used for assessing cost-effectiveness of the 2009 and 2012 IECC compared with the 2006 IECC at the national and state levels[3], and in analyzing cost-effectiveness of code change proposals developed by DOE for submission to the ICC in the development of the 2015 IECC.[4]

A. Changes and Issues Related to Estimating Energy Savings of Code Changes

The established methodology for estimating energy savings of residential code changes remains unchanged except for the following proposed revisions:

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[2] Taylor, T, N. Fernandez, and R. Lucas. 2012. Methodology for Evaluating Cost-effectiveness of Residential Energy Code Changes. DOE EERE Building Energy Codes Program. Available at: www.energycodes.gov/sites/default/files/documents/residential_methodology.pdf

[3] See: www.energycodes.gov/development/residential/iecc_analysis

[4] See: www.energycodes.gov/residential-code-change-proposals-2015-iecc

1. Prototypes

Single-family and multifamily residential building prototypes are used to assess the energy and cost impact of residential energy codes.[5] Minor revisions are proposed to prototype building characteristics to better align them with current construction practices or simplify the energy modeling process. Proposed changes are indicated in underline/strikeout format (with the unchanged characteristics included to provide context), and are summarized in Table II.1 and Table II.2.

The first proposed change to the DOE residential building prototypes surrounds the assumption for "area below roofs/ceilings" for both single- and multifamily buildings. DOE proposes to modify the former value of 70 percent with attic to a revised value of 100 percent. This change is intended to simplify the energy modeling process. The second proposed change focuses on the "internal gains" assumption for the single-family prototype, which is revised from a value of 91,436 Btu/day to 87,332 Btu/day. This change updates the previous assumption to align with Section 405 of the 2015 IECC. The third and final change modifies the "window area" assumption for the multifamily prototype, revised from a value of 14 percent relative to *conditioned floor area* to 23 percent relative to *exterior wall area* not including breezeway walls. Note that the revised exterior wall area *metric* is the target of the change (i.e., not the actual quantity of window area), and is considered to better reflect typical multifamily building construction.

[5] Mendon, V., and Z.T. Taylor. 2014. Development of Residential Prototype Building Models and Analysis System for Large-Scale Energy Efficiency Studies Using EnergyPlus. 2014 ASHRAE/IBPSA-USA Building Simulation Conference. Atlanta, GA.

DOE is seeking public input on these proposed revisions (Topic **R01**). Note that the non-revised content in the tables remains unchanged from the established methodology.

Table II.1 Single-Family Prototype Characteristics

Parameter	Assumption
Conditioned floor area	2,400 ft^2 (plus 1,200 ft^2 of conditioned basement, where applicable)
Footprint and height	30-ft-by-40 ft, two-story, 8.5-ft-high ceilings
Area above unconditioned space	1,200 ft^2
Area below roofs/ceilings	1,200 ft^2, ~~70% with attic, 30% cathedral~~ 100% with attic
Perimeter length	140 ft
Gross exterior wall area	2,380 ft^2
Window area (relative to conditioned floor area)	Fifteen percent equally distributed to the four cardinal directions (or as required to evaluate glazing-specific code changes)
Door area	42 ft^2
Internal gains	~~91,436 Btu/day~~ 87,332 Btu/day
Heating system	Natural gas furnace, heat pump, electric furnace, or oil-fired furnace
Cooling system	Central electric air conditioning
Water heating	Natural gas, or as required to evaluate domestic hot water-specific code changes
Foundation type	Slab-on-grade, vented crawlspace, heated basement and unheated basement

Table II.2 Multifamily Prototype Characteristics

Parameter	Assumption
Conditioned floor area	1,200 ft^2 per unit, or 21,600 ft^2 total (plus 1,200 ft^2 of conditioned basement on ground-floor units, where applicable)
Footprint and height	Each unit is 40 ft wide by 30 ft deep, with 8.5-ft-high ceilings. The building footprint is 120 ft by 65 ft.
Area above unconditioned space	1,200 ft^2 on ground-floor units
Wall area adjacent to unconditioned space	None
Area below roofs/ceilings	1,200 ft^2, ~~70% with attic, 30% cathedral~~ 100% with attic on top-floor units
Perimeter length	370 ft (total for the building), 10 ft of which borders the open breezeway
Gross wall area	5,100 ft^2 per story, 2,040 ft^2 of which faces the open breezeway (15,300 ft^2 total)
~~Window area (relative to conditioned floor area)~~	~~14%~~
Window area (relative to exterior wall area not including breezeway walls)	23%
Door area	21 ft^2 per unit (378 ft^2 total)
Internal gains	54,668 Btu/day per unit (984,024 Btu/day total)
Heating system	Natural gas furnace, heat pump, electric furnace, or oil-fired furnace
Cooling system	Central electric air conditioning
Water heating	Natural gas, or as required to evaluate domestic hot water-specific code changes
Foundation type	Slab-on-grade, vented crawlspace, heated basement and unheated basement

2. Weather Locations

DOE will continue to draw from a set of 119 climate locations comprised of one representative location for each climate zone and moisture regime within each state. The overall set of climate locations are described in the established residential methodology. However, DOE is proposing to apply fewer climate locations when a subset of locations is sufficient for specific analyses, such as DOE has applied in the past as part of its analysis surrounding commercial buildings.

In conducting national analyses, which tend to be less sensitive to regional variations in climates, DOE intends to utilize one representative weather location per climate zone, including a separate location for each moisture regime. This approach is

intended to conserve time and computing resources in situations where regional variation does not significantly impact overall findings. In addition, DOE may apply this approach in performing analyses that are preliminary or limited in nature, such as in analyzing individual code change proposals. The simulation results will be weighted to the national level using weighting factors from the established methodology rolled up to the national climate zone level for consistency between the two schemes. For aggregating results across foundation, heating system and building types the method will be similar to the current approach, but with fewer discrete weather locations.

A similar approach will be followed for state-level or other regional analyses, with DOE utilizing those climate locations (from the overall set) that are representative of the geographic area being analyzed. This selection will often include a number of distinct locations that adequately capture regional variation within the scope of the analysis, such as within a target state. In addition, the selection of locations in conducting state-level analyses may be modified based on what is deemed credible by the target audience. For analyses targeting a particular climate zone, results will be weighted using the regime weight within the climate zone.

The weather locations and resulting overall location construction weights for the national climate zones are summarized in Table II.3. DOE is seeking public input on the appropriateness of using fewer weather stations for national and preliminary analysis (Topic **R02**).

Table II.3 Climate Locations for the National Scheme with Weighting Factors

Climate Zone	Moisture Regime	Representative Location		Regime Weight within Zone (%)	Overall Location Weight (%)
		State	City		
1	Tropical	Hawaii	Honolulu	42	0.5
	Moist	Florida	Miami	58	0.7
2	Dry	Arizona	Phoenix	10	2.1
	Moist	Texas	Houston	90	18.4
3	Dry	Texas	El Paso	30	7.9
	Marine	California	San Francisco	5	1.3
	Moist	Tennessee	Memphis	65	16.9
4	Dry	New Mexico	Albuquerque	2	0.6
	Marine	Oregon	Salem	15	3.4
	Moist	Maryland	Baltimore	83	19.2
5	Dry	Idaho	Boise	23	4.9
	Moist	Illinois	Chicago	77	16.0
6	Dry	Montana	Helena	18	1.2
	Moist	Vermont	Burlington	82	5.6
7		Minnesota	Duluth	100	1.3
8		Alaska	Fairbanks	100	0.0

B. Changes and Issues Related to Estimating the Cost-effectiveness of Code Changes

DOE noticed typographical errors in two equations published in the established methodology where a term was not reproduced as intended. The corrected Equations 1 and 2 are included below (missing term is underlined):

$$Tax\ deduction_y =$$

$$Property\ Tax_y + R_{IT} \times Mortgage\ Payment \times \underline{R_{MI}} \times \left[\frac{1+R_{MI}^{T-y+1}-1}{R_{MI}\times 1+R_{MI}^{T-y+1}}\right] \quad (1)$$

$$mortgage\ fee = R_{MF} \times C \times \underline{(1 - R_{DP})} \quad (2)$$

DOE is not seeking public input on the changes to Equations 1 and 2.

III. Analysis of Commercial Buildings

The focus of this section of the RFI is commercial buildings, which DOE defines in a manner consistent with both ASHRAE Standard 90.1 and the IECC—buildings except one- and two-family dwellings, townhouses, and low-rise (three

stories or less above grade) multifamily residential buildings. DOE has developed a consistent and transparent methodology for assessing the cost-effectiveness of commercial code change proposals and for assessing the cost-effectiveness of new code versions.[6] This methodology, hereafter referred to as the "established commercial methodology," was used for assessing cost-effectiveness of ASHRAE Standards 90.1-2010 and 90.1-2013 and in supplementing cost-effectiveness criteria of certain code change proposals developed by DOE for submission to the ICC in the development of the 2015 IECC.[7]

A. Changes and Issues Related to Estimating Energy Savings of Code Changes

ASHRAE SSPC 90.1 has updated its representative cities based on changes in ASHRAE Standard 169-2013 (Climatic Data for Building Design Standards), and has adopted the revised climate zones into ASHRAE Standard 90.1. DOE has noted this change in the code, itself, as affecting DOE analysis. However, DOE is not seeking public comment on the use of the new representative cities for its analysis.

B. Changes and Issues Related to Estimating the Cost-effectiveness of Code Changes

1. Property Tax Impact

The proposed commercial methodology includes an adjustment to the life-cycle cost for the impact of property taxes. This is a change from the established commercial method that was used for the state cost-effectiveness analyses of ASHRAE Standard 90.1-2010 and the ASHRAE Standard 90.1-2013 analysis[8].

[6] Hart, R, and B. Liu. 2015. "Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes." DOE EERE Building Energy Codes Program. Available at: www.energycodes.gov/development/commercial/methodology.
[7] See: www.energycodes.gov/development/commercial/2015IECC
[8] See: http://www.energycodes.gov/development/commercial/cost_effectiveness.

Under the revised commercial methodology, the property tax impact is proposed to be included in Scenario 2 life-cycle cost as follows:

$$PV(P) = C(R_P)\left(\frac{(1+D_r)^L - 1}{D_r(1+D_r)^L}\right)(1 - R_{TF})$$

Where:

PV(P) = present value of property tax net of federal income tax benefit

C = incremental first costs

R_P = property tax rate

D_r = real discount rate

L = period of analysis

R_{TF} = income tax rate, federal

This proposed change from prior commercial cost-effectiveness practice to include property tax impacts makes the commercial method more robust and further consistent with the residential method. DOE is seeking public input on the appropriateness of the addition of property tax impact analysis to Scenario 2 of the cost-effectiveness methodology. (Topic **C01**).

IV. Common Issues for Both Residential and Commercial Buildings

There are common issues for both residential and commercial buildings related to cost estimate development when there are multiple paths to compliance and regarding the preferred sources of economic and other parameters.

A. Addressing Code Changes with Multiple Approaches to Compliance

As discussed in both methodologies, DOE anticipates that some new code provisions may have significantly different first costs depending on unrelated aesthetic choices or exceptions and flexibility options in the code. For example, a

requirement for window shading could be met with interior blinds, electro-chromatic windows, static exterior shades, or an active tracking exterior shading system. Or, a reasonable window-to-wall ratio may be set as a baseline for standard efficiency heating, ventilation, and cooling (HVAC) equipment, and exceeding that ratio may require more expensive higher efficiency HVAC equipment. It has been suggested, for example, that a future code may replace or supplement independent prescriptive requirements with options expected to provide similar energy cost and performance.

For any of these situations with multiple compliance paths, DOE intends to focus on the least-cost approach deemed to be effective and meet the code requirement rather than include the cost of niche or optional technology. For example, if there are multiple options available to comply with the code, and if one widely applicable and accepted option is found to be cost-effective, then the approach would be deemed cost-effective. This is because there is one cost-effective path through the code, and if a higher cost option is chosen, that is the developer or designer's choice.

Furthermore, some new code provisions may come with no specific construction changes at all, but rather be expressed purely as a performance requirement. DOE intends to evaluate any such code changes case-by-case and will search the research literature or conduct new analyses to determine the reasonable set of construction changes that could be expected to emerge in response to such new requirements.

DOE is seeking public input on the appropriateness of assessing the first cost where a new or changed requirement can be met by multiple construction approaches with varying cost implications (Topic **G01**).

B. Economic Parameters and Inputs

The data sources and procedures for establishing economic parameters required for calculating the metrics described above are described in detail in the established residential methodology and established commercial methodology (see *Analysis for Residential Buildings* and *Analysis for Commercial Buildings* sections of this notice). DOE will use the most recent values of these parameters available at the time an analysis is begun. DOE is seeking public input on whether this approach can be improved through use of data sources not included in the established commercial and residential methodologies (Topic **G02**).

V. Public Participation

A. Submission of Information

DOE will accept information in response to this notice under the timeline provided in the **DATES** section of this notice. Comments should be submitted by one of the methods listed in the **ADDRESSES** section of this notice. Comments should include the topic identifier (e.g., G01, R01, R02, C01, C02, etc.) in the subject line and throughout the submission, as applicable, to aid in associating comments with the requested topics. In summary, DOE is particularly interested in receiving information on the following issues/topics:

B. General Issues on which DOE Seeks Information

G01. The appropriateness of assessing the first cost where a new or changed requirement can be met by multiple construction approaches with varying cost implications

G02. Suggestions for preferred cost and economic parameter data sources

C. Residential Issues on which DOE Seeks Information

R01. The appropriateness of revisions to the prototypes used for residential analysis

R02. The appropriateness of using fewer weather stations for national and preliminary analysis

R03. Other comments on DOE's residential cost-effectiveness methodology for code change analysis

D. Commercial Issues on which DOE seeks Information

C01. The appropriateness of the addition of property tax impact analysis to the Scenario 2 cost-effectiveness methodology

C02. Other comments on DOE's commercial cost-effectiveness methodology for code change analysis

Issued in Washington, DC, on March 16, 2015

David Cohan

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