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DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy

[Docket No. EERE-2014-BT-DET-0009]

RIN 1904-AD27

Determination Regarding Energy Efficiency Improvements in ANSI/ASHRAE/IES Standard 90.1-2013: Energy Standard for Buildings, Except Low-Rise Residential Buildings

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

ACTION: Notice of determination.

SUMMARY: The U.S. Department of Energy (DOE) has determined that the 2013 edition of the ANSI/ASHRAE/IES Standard 90.1: *Energy Standard for Buildings, Except Low-Rise Residential Buildings* would improve energy efficiency in buildings subject to the code compared to the 2010 edition of Standard 90.1. DOE has determined that buildings built to Standard 90.1-2013, as compared with buildings built to Standard 90.1-2010, would result in national source energy savings of approximately 8.5 percent and site energy savings of approximately 7.6 percent of commercial building energy consumption. Upon publication of this affirmative determination, States are required to certify that they have reviewed the provisions of their commercial building code regarding energy efficiency, and, as necessary, updated their codes to meet or exceed Standard 90.1-2013. Additionally, this notice provides guidance to States on certifications and requests for extensions of deadlines for certification statements.

DATES: Certification statements provided by States must be submitted by September 28, 2015.

ADDRESSES: Certification Statements must be addressed to the Building Technologies Office—Building Energy Codes Program Manager, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, 1000

Independence Avenue SW., EE-5B, Washington, DC 20585.

FOR FURTHER INFORMATION CONTACT:

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For legal issues, please contact Kavita Vaidyanathan; U.S. Department of Energy, Office of the General Counsel, 1000 Independence Avenue SW., GC-71, Washington, DC 20585; (202) 586-0669; *Kavita.Vaidyanathan@hq.doe.gov.*

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I. Statutory Authority

Title III of the Energy Conservation and Production Act, as amended (ECPA), establishes requirements for building energy conservation standards, administered by the DOE Building Energy Codes Program. (42 U.S.C. 6831 *et seq.*) Section 304(b), as amended, of ECPA provides that whenever the ANSI/ASHRAE/IESNA Standard 90.1-1989 (Standard 90.1-1989 or 1989 edition), or any successor to that code, is revised, the Secretary of Energy (Secretary) must make a determination, not later than 12 months after such revision, whether the revised code would improve energy efficiency in commercial buildings, and must publish notice of such determination in the **Federal Register**. (42 U.S.C. 6833(b)(2)(A)) The Secretary may determine that the revision of Standard 90.1-1989, or any successor thereof, improves the level of energy efficiency in commercial buildings. If so, then not later than 2 years after the date of the publication of such affirmative determination, each State is required to certify that it has reviewed and updated the provisions of its commercial building code regarding energy efficiency with respect to the revised or successor code. (42 U.S.C. 6833(b)(2)(B)(i)) Each State must include in its certification a demonstration that the provisions of its commercial building code, regarding energy efficiency, meet or exceed the revised Standard. (42 U.S.C. 6833(b)(2)(B)(i))

If the Secretary makes a determination that the revised Standard will not improve energy efficiency in commercial buildings, State commercial codes shall meet or exceed the last

revised Standard for which the Secretary has made an affirmative determination. (42 U.S.C. 6833(b)(2)(B)(ii)) On October 19, 2011, DOE published its determination in the **Federal Register** updating the reference code to Standard 90.1-2010. (76 FR 64904)

ECPA also requires the Secretary to permit extensions of the deadlines for the State certification if a State can demonstrate that it has made a good faith effort to comply with the requirements of Section 304(b) of ECPA and that it has made significant progress in doing so. (42 U.S.C. 6833(c)) DOE is also directed to provide technical assistance to States to support implementation of State residential and commercial building energy efficiency codes. (42 U.S.C. 6833(d))

II. Introduction

Publication of Standard 90.1-2013

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and Illuminating Engineering Society (IES) approved the publication of the 2013 edition of *Energy Standard for Buildings Except Low-Rise Residential Buildings* in October 2013. The Standard is developed under ANSI-approved consensus procedures,² and is under continuous maintenance by a Standing Standard Project Committee. ASHRAE has established a program for regular publication of addenda, or revisions, including procedures for timely, documented, consensus action on requested changes to the Standard. The American National Standards Institute (ANSI) approved the final addendum for inclusion in the 2013 edition in September 2013. Standard 90.1-2013 was published in October 2013.³ More information on ANSI/ASHRAE/IES Standard 90.1-2013 is available at: <https://www.ashrae.org/resources-publications/bookstore/standard-90-1>.

DOE Determination

In arriving at its determination, DOE reviewed all changes between the 2013 and 2010 editions of Standard 90.1. Standard 90.1 is complex and covers a broad spectrum of the energy-related components and systems in buildings, ranging from simpler commercial buildings to more complex hospitals and laboratory facilities. Standard 90.1-

² An overview of the ANSI consensus process is available at http://www.ansi.org/standards-activities/domestic_programs/overview.aspx?menuid=3.

³ ASHRAE press release available at <https://www.ashrae.org/news/2013/ashrae-ies-publish-2013-energy-standard-changes-for-envelope-lighting-mechanical-sections>.

¹ American National Standards Institute (ANSI)/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society (IES).

2013 was developed through the same approach as the previous 2010 edition, which involves committee approval through a consensus process consistent with ANSI procedures for developing industry standards. The 2013 edition contains no significant changes to the overall scope or the structure of the Standard. As a result, DOE preliminarily determined that the methodology used for the analysis of Standard 90.1–2010 should again be utilized for the analysis of Standard 90.1–2013. DOE published a Notice of Preliminary Determination regarding Standard 90.1–2013 in the **Federal Register** on May 15, 2014. (79 FR 27778)

Public Comments Regarding the Determination

DOE accepted public comments on the Notice of Preliminary Determination for Standard 90.1–2013 until June 16, 2014. DOE received timely submissions from a total of three commenters. These comments are discussed below.

Jim Ranfone submitted a written document (Docket No. EERE–2014–BT–DET–0009–0002) containing three comments. In his first comment, Mr. Ranfone questions the economic basis of Standard 90.1, in particular the fact that ASHRAE does not use marginal costs for natural gas. Mr. Ranfone indicates that this will overstate the cost savings from the energy upgrades in the Standard. In response, DOE notes that it is directed by statute to evaluate published editions of Standard 90.1 and issue a determination as to whether the updated edition will result in energy savings in commercial buildings. DOE is not given the authority to dictate specific economic criteria informing the decisions of the ASHRAE Standard 90.1 Committee. DOE notes that the membership of the ASHRAE Standard 90.1 Committee, itself, develops economic criteria to inform its decisions surrounding the cost-effectiveness of proposed code changes. As a national model, the Standard 90.1 Committee chose to reference national average values in the development of the Standard. In his second comment, Mr. Ranfone questioned the use of a blended rate for heating costs. He contends that the blended rate skews the basic energy cost assumptions by overstating efficiency improvements that affect natural gas, and understating electric savings for improvements affecting electricity savings. In response, DOE notes that it is directed by statute to evaluate published editions of Standard 90.1, and issue a determination as to whether the updated edition will result in energy savings in commercial buildings. DOE is not given the

authority to dictate specific cost parameters and other economic criteria informing the decisions of the ASHRAE Standard 90.1 Committee. Specific to the topic of “blended” utility costs, DOE has reviewed the economic criteria established by the ASHRAE Standard 90.1 Committee, and notes criteria employed in Standard 90.1–2013 as consistent with past criteria used in the development of the Standard—an approach that appears unchanged since the development of Standard 90.1–1999. In his third comment, Mr. Ranfone also questioned the inclusion of requirements in Standard 90.1–2013 that are neutral in terms of energy efficiency, but which would add costs for compliance, specifically citing requirements for electric and fuel meters. In response, DOE again notes its statutory role in assessing energy savings associated with Standard 90.1, and in issuing a determination of energy savings for commercial buildings. DOE is not given the authority to reconcile costs of specific code provisions, or overall economics surrounding updated codes, as part of its energy savings determination. Rather, such consideration is provided directly as part of the code development and consensus process. In general, DOE acknowledges that code changes which do not have a direct impact on energy efficiency are common, including a number of changes in Standard 90.1–2013. Such changes often target an alternative objective, such as improved code usability or enforceability, but which otherwise seek to improve the design and construction of energy efficient buildings. Within the context of the DOE determination, individual addenda included in Standard 90.1–2013 are identified and further evaluated in the supplementary technical support documents.

The Responsible Energy Codes Alliance (RECA) submitted a written document (Docket No. EERE–2014–BT–DET–0009–0003) containing five comments. In its first comment, RECA encourages the Department to provide an itemized comparison between Standard 90.1 and the IECC. DOE has previously conducted this type of additional analysis as technical assistance for States and adopting localities in understanding the provisions of the respective editions of Standard 90.1 and the IECC. DOE acknowledges the comparison between Standard 90.1 and the IECC as an important resource for States. In line with historical practice, and as budgets allow, DOE may prepare such a comparison for Standard 90.1–2013 and

the 2015 IECC commercial provisions. RECA encourages the Department to quickly finalize this Determination. DOE understands the importance of fulfilling its directives in a timely manner, and intends to complete its determination within the statutory timeline set forth in 42 U.S.C. 6833(b)(2)(A). In its third comment, RECA strongly encourages the Department to provide resources to improve the overall compliance rates with commercial energy codes, as well as compliance with specific sections. DOE recognizes the significant energy savings potential associated with ensuring code-intended energy savings, and acknowledges the importance of resources to improve compliance rates. In a continuing effort, DOE intends to provide technical assistance in the form of training materials and support for commercial codes in order to improve compliance rates. DOE also recently issued a Funding Opportunity Announcement (FOA) for improving residential energy code compliance, and, in the future, will investigate means of providing additional support pertaining to commercial energy codes. In its fourth comment, RECA does not believe that DOE may consider cost-effectiveness as part of its determination process, but does believe that DOE should provide cost-effectiveness analyses to States. As DOE has stated in its Notice of Preliminary Determination, it did not evaluate cost-effectiveness as part of its energy savings determination. However, DOE intends to continue providing national and state-level cost-effectiveness analyses as technical assistance to States, as has been completed in the past for Standard 90.1–2010 at http://www.energycodes.gov/development/commercial/cost_effectiveness. In its fifth comment, RECA believes the DOE cost-effectiveness methodology is a reasonable compromise representing diverse stakeholder interests, and that the Department should maintain the same methodology for Standard 90.1–2013 and the 2015 IECC. DOE also acknowledges RECA’s previous comments on the cost-effectiveness methodology in Docket No. EERE–2011–BT–BC–0046. In response, DOE intends to continue to use its current cost-effectiveness methodology for analysis of Standard 90.1–2013. In addition, DOE is looking into the possibility of updating its methodology for evaluating the cost-effectiveness of building energy codes through a public request for information in the coming months, and to be used in analyzing future building energy codes and standards. DOE may

issue a request for information prior to finalizing the new methodology.

The Edison Electric Institute (EEI) submitted a written document (Docket No. EERE-2014-BT-DET-0009-0004) containing three comments. In its first comment, EEI suggests DOE should only use site energy and energy cost results in its determination on Standard 90.1-2013, and that source energy results should not be used. DOE notes that EEI submitted a similar comment on the Notice of Preliminary Determination for Standard 90.1-2010. DOE considered the comment again and is again rejecting the comment. DOE continues to believe that, in addition to the site metric, source energy estimates are important to the discussion of global resources and environmental issues. In its second comment, EEI suggests energy savings from new or updated Federal appliance and equipment standards should be incorporated into the determination on Standard 90.1-2013. DOE notes that EEI submitted a similar comment on the Notice of Preliminary Determination for Standard 90.1-2010. DOE considered the comment again and is again rejecting the comment. Many appliance and equipment standards are not established directly within Standard 90.1, but rather are established by the Federal government. For this reason, DOE continues to believe that energy savings resulting from new or updated Federal standards should not be incorporated into its determinations. In its third comment, EEI suggests that value associated with primary energy for electricity is overstated based on four specific reasons: (1) DOE considered only commercial customers, not residential and industrial customers; (2) the EIA fossil fuel heat rate is too high; (3) on-site renewable energy is included in EIA's data and that inflates the primary energy data; and (4) estimates of primary energy values should look forward not backward. DOE notes that EEI submitted a similar comment on the Notice of Preliminary Determination for Standard 90.1-2010. DOE considered the comment again and is again rejecting the comment because DOE continues to believe that its use of EIA data, conversion factors, and treatment of renewable energy is appropriate.

In its Notice of Preliminary Determination, DOE expressed interest in receiving stakeholder feedback on the Department's practice of providing cost-effectiveness analysis to support State

energy code adoption. DOE has issued past requests to guide the Department in establishing an appropriate methodology for evaluating the cost effectiveness of building energy codes (78 FR 47677), and expects to update this method to ensure its assumptions and economic criteria remain valid and adequate for States considering adoption of model building energy codes. During the public comment period, DOE did not receive any comments (*i.e.*, outside of factors acknowledged above) on the overall costs and benefits associated with building energy codes. In the coming months, DOE intends to issue a public request for information to update its cost-effectiveness analysis methodology, and in preparation to continue providing such technical analysis and assistance to States implementing building energy codes.

III. Methodology

Overview of Methodology

The analysis methodology used by DOE contains both qualitative and quantitative components. A qualitative comparison is undertaken to identify textual changes between requirements in Standard 90.1-2013 and Standard 90.1-2010, followed by a quantitative assessment of energy savings conducted through whole-building simulations of buildings constructed to meet the minimum requirements of each Standard over the range of U.S. climates. A discussion of the analysis methodology, which was developed through public comment in past DOE determinations, can be found in the Notice of Preliminary Determination for Standard 90.1-2007 (75 FR 54117) and Notice of Preliminary Determination for Standard 90.1-2010 (76 FR 43298).

Consistent with its previous determinations, DOE compared overall editions of Standard 90.1. DOE interprets the language in Section 304(b)(2) of ECPA to mean that when a comprehensive revision of the ASHRAE Standard is published (which in this case is ASHRAE Standard 90.1-2013), then that revised or successor Standard triggers the Secretary's obligation to issue a determination as to whether the revised Standard improves energy efficiency in commercial buildings. (See 42 U.S.C. 6833(b)(2)(A)) This determination is made by comparing the revised or successor Standard to the last predecessor Standard. While the

continuous addenda review and update process is part of the ongoing maintenance of the Standard, DOE does not interpret each addendum update after the release of the full standard as an additional "revised or successor standard" requiring a determination by the Secretary.

IV. Summary of Findings

In performing its determination, DOE performed both a qualitative and quantitative analysis of the requirements contained in Standard 90.1-2013. The chosen methodology for these analyses is consistent with recent determinations actions, and provides a reasonable assessment of how the Standard will impact energy savings in commercial buildings. A summary of the analyses supporting DOE's determination is outlined in the following sections.

Qualitative Analysis

DOE performed a comparative analysis of the textual requirements of Standard 90.1-2013, examining the specific changes (addenda) made between Standard 90.1-2010 and Standard 90.1-2013. ASHRAE publishes changes to its standards as individual addenda to the preceding Standard, and then bundles all addenda together to form the next published edition. In creating the 2013 edition, ASHRAE processed 110 total addenda. DOE evaluated each of these addenda in preparing its determination of energy savings.

Overall, DOE found that the vast majority of changes in creating Standard 90.1-2013 were positive (*i.e.*, increased energy savings) or neutral (*i.e.*, no direct impact on energy savings). Positive changes significantly outweigh any changes with a negative effect on energy efficiency in commercial buildings. Of the 110 total changes:

- 52 were considered positive;
- 53 were considered neutral; and
- 5 were considered negative.

Table IV.1 presents the findings resulting from the qualitative analysis, along with a description of the change, as well as an assessment of the anticipated impact on energy savings in commercial buildings. The full qualitative analysis is presented in a separate technical support document (TSD),⁴ available at <http://www.energycodes.gov/regulations/determinations>.

⁴ Halverson et al., *ANSI/ASHRAE/IES Standard 90.1-2013 Determination of Energy Savings*:

Qualitative Analysis (PNNL, Richland, WA (US), July 2014), available at http://www.pnnl.gov/main/publications/external/technical_reports/pnnl-23481.pdf.

TABLE IV.1—QUALITATIVE ANALYSIS FINDINGS

Number	Addendum to standard 90.1–2010 ⁵	Sections affected within the standard	Description of changes	Impact on energy efficiency (justification)
1	90.1–2010a	10. Other Equipment and 12. Normative References.	Specifies that nominal efficiencies for motors are required to be established in accordance with 10 CFR 431 instead of National Electrical Manufacturers Association (NEMA) Standards. Modifies the footnotes to Tables 10.8A, 10.8B, 10.8C (now Tables 10.8–1, 10.8–2, and 10.8–3 in Standard 90.1–2013). The corresponding reference for 10 CFR 431 has also been added.	Neutral (simply specifies alternate rating standard).
2	90.1–2010b	10. Other Equipment and 12. Normative References.	Requires escalators and moving walks to automatically slow when not conveying passengers. The corresponding reference to American Society of Mechanical Engineers (ASME) A17.1/CSA B44 has also been added to the Normative References.	Minor + (reduces escalator and moving walkway energy).
3	90.1–2010c	Appendix G	Adds requirements for laboratory exhaust fans to Section G3.1.1, Baseline HVAC System Type and Definition. Lab exhaust fans are required to be modeled as constant horsepower, reflecting constant volume stack discharge with outside air bypass.	Neutral (whole building performance tradeoff method only).
4	90.1–2010e	Appendix G	Updates language in Section G3.1, part 5, “Building Envelope,” to require that existing buildings use the same envelope baseline as new buildings with the exception of fenestration area.	Neutral (whole building performance tradeoff method only).
5	90.1–2010f	Appendix G	Modifies Section G.3.1, “Building Envelope.” Specifies the vertical fenestration area for calculating baseline building performance for new buildings and additions.	Neutral (whole building performance tradeoff method only).
6	90.1–2010g	6. Heating, Ventilating, and Air-Conditioning and 12. Normative References.	Adds efficiency requirements for commercial refrigerators, freezers, and refrigeration equipment. Table 6.8.1L and Table 6.8.1M (now Tables 6.8.1–12 and 6.8.1–13 in Standard 90.1–2013) have been added, which specify the energy use limits for refrigerators and freezers. The corresponding references have also been added in Chapter 12.	Neutral (adopts Federal standards).
7	90.1–2010h	6. Heating, Ventilating, and Air-Conditioning.	Modifies the minimum efficiency standards for water-to-air heat pumps (water loop, ground water, and ground loop). The proposed cooling energy efficiency ratios (EERs) and heating coefficients of performance are more stringent than the present values. Also removes the small duct high velocity heat pump product class from Table 6.8.1B (now Table 6.8.1–2 in Standard 90.1–2013).	Minor + (increases stringency of existing requirements).
8	90.1–2010i	6. Heating, Ventilating, and Air-Conditioning and 3. Definitions.	Increases the minimum efficiency standards for single-package vertical air conditioners (SPVAC) and single-package vertical heat pumps (SPVHP). Also creates a new product class for SPVAC and SPVHP used in space-constrained applications. This new product class only applies to non-weatherized products with cooling capacities <36,000 British thermal units per hour (Btu/h) and intended to replace an existing air-conditioning (AC) unit.	Minor + (increases stringency of existing requirements).
9	90.1–2010j	6. Heating, Ventilating, and Air-Conditioning.	Modifies the minimum efficiency requirements of evaporatively cooled units, of size category 240,000 Btu/h to 760,000 Btu/h and heating type-other, in Table 6.8.1A (now Table 6.8.1–1 in Standard 90.1–2013). The value is reduced to account for increased pressure drop in such system types. The product class, small duct high velocity air conditioner, has been eliminated.	Minor—(due to correction of an error in the previous Standard).
10	90.1–2010k	8. Power and 12. Normative References.	Modifies notes to Table 8.1 and specifies that nominal efficiencies would be established in accordance with the 10 CFR 431 test procedure for low-voltage dry-type transformers. The corresponding references have also been added in Chapter 12.	Neutral (simply specifies alternative rating standard).
11	90.1–2010l	6. Heating, Ventilating, and Air-Conditioning.	Clarifies fan power limitations contained in Standard 90.1–2010 that required the user to perform calculations for fan brake horsepower (bhp) even if the simplified nameplate horsepower (hp) option was being used.	Neutral (editorial correction).
12	90.1–2010m	9. Lighting	Adds some control requirements for lighting alterations, for interior and exterior applications. Adds a section for submittals and includes loading docks as a tradable surface. Modifies the provisions for additional interior lighting power, which would now be calculated on the basis of controlled wattage.	Major + (adds control requirements for lighting alterations).

TABLE IV.1—QUALITATIVE ANALYSIS FINDINGS—Continued

Number	Addendum to standard 90.1–2010 ⁵	Sections affected within the standard	Description of changes	Impact on energy efficiency (justification)
13	90.1–2010n	10. Other Equipment	Clarifies that the total lumens per watt for the entire elevator cab is required to meet the efficiency requirement and that each individual light source is not required to meet the lumens per watt value.	Neutral (clarification only).
14	90.1–2010o	5. Building Envelope and 3. Definitions.	Adds the definition for sectional garage doors. Also modifies Section 5.4.3.2 (d), “fenestration air leakage provisions for doors,” to include requirements for glazed sectional garage doors.	Minor + (reduces air leakage in glazed sectional garage doors).
15	90.1–2010p	5. Building Envelope and 12. Normative References.	Modifies Section 5.5.3.1 and requires roof solar reflectance and thermal emittance testing to be in accordance with Cool Roof Rating Council (CRRC)–1 Standard. Also modifies Section 12 by adding the reference for CRRC.	Neutral (simply specifies an alternative rating standard).
16	90.1–2010q	3. Definitions, 5. Building Envelope, and 12. Normative References.	Modifies Section 3 by changing the definition of dynamic glazing to include glazing systems or infill as well as shading systems between glazing layers and chromogenic glazing. Also modifies Section 5.8.2.2 by clarifying the requirements for labeling of fenestration and door products. The corresponding references to National Fenestration Rating Council (NFRC) in Chapter 12 have also been updated.	Neutral (clarification only).
17	90.1–2010r	Appendix G and 12. Normative References.	Clarifies the requirements related to temperature and humidity control in Appendix G and relocates all related wording to the “Schedules” section of Table 3.1. Additionally, clarity is provided for modeling systems that provide occupant thermal comfort via means other than directly controlling the air dry-bulb and wet-bulb temperature (<i>i.e.</i> , radiant cooling/heating, elevated air speed, etc.). Permits the use of ASHRAE Standard 55 for calculation of Predicted Mean Vote–Predicted Percentage Dissatisfied (PMV–PPD). Also updates the Normative References by including a reference to ASHRAE Standard 55–2010.	Neutral (whole building performance tradeoff method only).
18	90.1–2010s	6. Heating, Ventilating, and Air-Conditioning.	Modifies the requirement for the static pressure sensor location and the control requirements for setpoint reset for systems with direct digital control (DDC) of individual zones. Ensures that savings from previously required static pressure reset will be realized.	Minor + (ensures savings from static pressure reset are achieved).
19	90.1–2010u	6. Heating, Ventilating, and Air-Conditioning, 3. Definitions, and 12. Normative References.	Adds new definition as Fan Efficiency Grade (FEG) and requires each fan have a FEG of 67 or higher as defined by Air Movement and Control Association (AMCA) 205–10, “Energy Efficiency Classification for Fans”.	Major + (applies new requirements to individual fans).
20	90.1–2010v	8. Power	Clarifies the requirement for controlled receptacles in open offices applications by changing the requirement to the workstations themselves. Also requires the automatically controlled receptacles to be appropriately identified for the user’s benefit.	Neutral (clarification only).
21	90.1–2010w	3. Definitions, 11. Energy Cost Budget Method, and Appendix G.	Adds definitions for on-site renewable energy and purchased energy. Clarifies the process for accounting for on-site renewable energy and purchased energy as well as calculating the annual energy costs in the ECB approach and Appendix G.	Neutral (whole building performance tradeoff method only).
22	90.1–2010y	3. Definitions and 10. Other Equipment.	Revises the definitions of general purpose electric motors (subtype I & II) based on information from NEMA. Also updates the Standard to include the new Federal energy efficiency standards used in HVAC equipment, to be in effect from 2015. Adds Table 10.8D (now Table 10.8–4 in Standard 90.1–2013), which specifies minimum average full-load efficiency for Polyphase Small Electric Motors; and Table 10.8E (now Table 10.8–5 in Standard 90.1–2013), which specifies minimum average full-load efficiency for Capacitor-Start Capacitor-Run and Capacitor-Start Induction-Run Small Electric Motors.	Neutral (adopts Federal standards).
23	90.1–2010z	6. Heating, Ventilating, and Air-Conditioning.	Relocates the requirements for water economizers into the main economizer section, Section 6.5.1.5.	Neutral (editorial only).

TABLE IV.1—QUALITATIVE ANALYSIS FINDINGS—Continued

Number	Addendum to standard 90.1–2010 ⁵	Sections affected within the standard	Description of changes	Impact on energy efficiency (justification)
24	90.1–2010aa	6. Heating, Ventilating, and Air-Conditioning and 3. Definitions.	Eliminates the contingency on DDC system existence for setpoint overlap restrictions, humidification and dehumidification controls, variable air volume (VAV) fan control setpoint reset, multiple-zone VAV system ventilation optimization control, hydronic system differential pressure reset by valve position. Instead specifies for what system types or sizes DDC is required in new buildings and alterations. Also specifies minimal functional requirements for DDC systems. (Prior to this addendum certain controls requirements were only required when the controls were provided by a DDC system).	Minor + (requires additional HVAC controls).
25	90.1–2010ad	12. Normative References.	Adds reference to specific addenda to Air-Conditioning, Heating, and Refrigeration Institute (AHRI) standards 340/360 and 1230 being referenced.	Neutral (updates references only).
26	90.1–2010ae	12. Normative References.	Adds reference to specific addenda to AHRI standards 210/240 and 550/590 being referenced.	Neutral (updates references only).
27	90.1–2010af	6. Heating, Ventilating, and Air-Conditioning.	Modifies heat rejection equipment (cooling tower) requirements to require that variable speed drive controlled fans operate all fans at the same speed instead of sequencing them, and require that open-circuit towers with multiple cells operate all cells in parallel down to 50% of design flow.	Minor + (reduces cooling tower energy usage).
28	90.1–2010ag	Appendix G and 12. Normative References.	Establishes a method for gaining credit in Appendix G for buildings that undergo whole building air leakage testing to demonstrate that they have an airtight building.	Neutral (whole building performance tradeoff method only).
29	90.1–2010ah	Appendix G	Sets system sizing requirements in Appendix G for humid climates based on humidity ratio instead of supply air temperature differential. Sets baseline system dehumidification requirements.	Neutral (whole building performance tradeoff method only).
30	90.1–2010ai	Appendix G	Modifies Appendix G to account for three prescriptive addenda that were incorporated into Standard 90.1–2010, but did not make it into Appendix G in time for publication. Updates economizer requirements to match addendum cy, establishes baseline transformer efficiency requirements to match addendum o, and establishes path A for centrifugal chiller baselines from addendum m.	Neutral (whole building performance tradeoff method only).
31	90.1–2010aj	6. Heating, Ventilating, and Air-Conditioning.	Requires fractional horsepower motors $\geq 1/12$ hp to be electronically commutated motors or have a minimum 70% efficiency in accordance with 10 CFR 431. Also requires adjustable speed or other method to balance airflow.	Minor + (reduces fractional horsepower motor energy usage).
32	90.1–2010al	Appendix G	Establishes a consistent fuel source for space heating for baseline systems based on climate zone. Establishes a consistent fuel source for service water heating (SWH) based on building type.	Neutral (whole building performance tradeoff method only).
33	90.1–2010am ...	6. Heating, Ventilating, and Air-Conditioning.	Establishes minimum turndown for boilers and boiler plants with design input power of at least 1,000,000 Btu/h.	Major + (reduces energy usage for large boilers).
34	90.1–2010an	Appendix C	Rewrites entire Appendix C to use a simulation based approach for envelope tradeoffs.	Neutral (alternative compliance method only).
35	90.1–2010ap	6. Heating, Ventilating, and Air-Conditioning and 3. Definitions.	Adds power usage effectiveness (PUE) as an alternative compliance methodology for data centers.	Neutral (alternative compliance method only).
36	90.1–2010aq	6. Heating, Ventilating, and Air-Conditioning and 11. Energy Cost Budget.	Expands the requirements for fan speed control for both chilled water and unitary direct expansion systems. In addition enhances the requirements for integrated economizer control and defines direct expansion unit capacity staging requirements.	Major + (reduces fan energy usage).
37	90.1–2010ar	6. Heating, Ventilating, and Air-Conditioning and 3. Definitions.	Adds mandatory and prescriptive requirements for walk-in coolers and freezers and refrigerated display cases.	Neutral (adopts Federal standards).
38	90.1–2010as	6. Heating, Ventilating, and Air-Conditioning.	Requires humidifiers mounted in the airstream to have an automatic control valve shutting off preheat when humidification is not required, and insulation on the humidification system dispersion tube surface. (Avoidance of simultaneous heating and cooling at air-handling unit).	Minor + (reduces humidification energy usage).

TABLE IV.1—QUALITATIVE ANALYSIS FINDINGS—Continued

Number	Addendum to standard 90.1–2010 ⁵	Sections affected within the standard	Description of changes	Impact on energy efficiency (justification)
39	90.1–2010at	3. Definitions, 5. Building Envelope, and 9. Lighting.	Deletes the term “clerestory” and instead adds “roof monitor” and clarifies the definition. Changes the references in Chapters 5 and 9 from clerestory to roof monitor.	Neutral (clarification only).
40	90.1–2010au	6. Heating, Ventilating, and Air-Conditioning.	Modifies Table 6.5.3.1.1B, which addresses fan power limitation pressure drop adjustment credits. Deductions from allowed fan power are added for systems without any central heating or cooling as well as systems with electric resistance heating. Sound attenuation credit is modified to be available only when there are background noise criteria requirements.	Minor + (restricts sound attenuation credit and adds deductions for certain systems).
41	90.1–2010av	6. Heating, Ventilating, and Air-Conditioning.	Modifies Section 6.5.1, exception k, applicable to Tier IV data centers, to make economizer exceptions more stringent and in agreement with ASHRAE TC 9.9.	Minor + (reduces number of exceptions).
42	90.1–2010aw	11. Energy Cost Budget and Appendix G.	Updates the reference year for ASHRAE Standard 140 and exempts software used for ECB and Appendix G compliance from having to meet certain sections of ASHRAE Standard 140.	Neutral (whole building performance tradeoff method only).
43	90.1–2010ax	Appendix G	Modifies Table G3.1, Part 14 of Appendix G to exclude the condition that permits a building surface, shaded by an adjacent structure, to be simulated as north facing if the simulation program is incapable of simulating shading by adjacent structures.	Neutral (whole building performance tradeoff method only).
44	90.1–2010ay	3. Definitions and 9. Lighting.	Modifies daylighting requirements. Modifies definitions for daylight area under skylights, daylight area under roof monitors, primary sidelight area, and secondary sidelight area. Changes the criterion for applying automatic daylighting control for sidelighting and toplighting to a controlled lighting power basis and provides characteristics for the required photo controls. Adds control requirements for secondary sidelighted areas. Modifies Table 9.6.2 to include continuous dimming in secondary sidelighted areas, which is now based on an installed wattage rather than area of the space. Eliminates the need for effective aperture calculation.	Minor + (requires additional controls).
45	90.1–2010az	6. Heating, Ventilating, and Air-Conditioning.	Increases the minimum efficiency of open circuit axial fan cooling towers. An additional requirement has been added for all types of cooling towers which states that the minimum efficiency requirements applies to the tower including the capacity effect of accessories which affect thermal performance. An additional footnote clarifies that the certification requirements do not apply to field erected cooling towers.	Minor + (increase efficiency of cooling towers).
46	90.1–2010ba	6. Heating, Ventilating, and Air-Conditioning.	Adds requirements for door switches to disable or reset mechanical heating or cooling when doors without automatic door closers are left open.	Minor + (reduces heating and cooling when doors are left open).
47	90.1–2010bb	3. Definitions, 5. Building Envelope, 11. Energy Cost Budget Method, and Appendix A.	Modifies the building envelope requirements for opaque assemblies and fenestration in tables 5.5.1 through 5.5.8. Adds and modifies text in Section 5. Adds new visible transmittance (VT) requirement through Section 5.5.4.5. Also updates the NFRC 301 reference, references in Section 11, and modifies two metal building roof assemblies in Table A2.3.	Major + (increases stringency of building envelope requirements).
48	90.1–2010bc	9. Lighting	Modifies requirements for automatic lighting control for guest-room type spaces. Exceptions to this requirement are lighting and switched receptacles controlled by captive key systems.	Minor + (requires automatic control of lighting and switched receptacles in hotel rooms).
49	90.1–2010bd	9. Lighting	Adds more specific requirements for the functional testing of lighting controls, specifically, occupancy sensors, automatic time switches, and daylight controls.	Minor + (improves functional testing of lighting controls).
50	90.1–2010be	9. Lighting	Makes minor revisions to Section 9.7.2.2, which addresses the scope of the operating and maintenance manuals required for lighting equipment and controls.	Neutral (clarification only).

TABLE IV.1—QUALITATIVE ANALYSIS FINDINGS—Continued

Number	Addendum to standard 90.1–2010 ⁵	Sections affected within the standard	Description of changes	Impact on energy efficiency (justification)
51	90.1–2010bf	8. Power	Addresses Section 8.4.2 on automatic receptacle control and increases the spaces where plug shutoff control is required. Clarifies the application of this requirement for furniture systems, lowers the threshold for turn off from 30 to 20 minutes, states a labeling requirement to distinguish controlled and uncontrolled receptacles and restricts the use of plug-in devices to comply with this requirement.	Minor + (reduces plug loads).
52	90.1–2010bg	5. Building Envelope	Adds low-emissivity (low-E) requirements for storm window retrofits.	Minor + (requires low-E storm windows in retrofits).
53	90.1–2010bh	9. Lighting	Modifies Table 9.6.1 Space-By-Space Lighting Power Density allowance.	Minor + (overall lighting power densities are reduced).
54	90.1–2010bi	6. Heating, Ventilating, and Air-Conditioning.	Increases seasonal energy efficiency ratio and heating seasonal performance factor for air-cooled commercial air conditioners and heat pumps below 65,000 Btu/h. (Effective 1/1/2015).	Minor + (increases stringency of existing requirements).
55	90.1–2010bj	6. Heating, Ventilating, and Air-Conditioning.	Re-establishes the product class for small duct high velocity air conditioners and heat pumps. Adds efficiency requirements for systems at <65,000 Btu/h below level of current Federal standards.	Neutral (re-establishes efficiency requirements that do not meet the level of Federal standards).
56	90.1–2010bk	6. Heating, Ventilating, and Air-Conditioning.	Increases cooling efficiency for packaged terminal air conditioners.	Minor + (increases stringency of existing requirements).
57	90.1–2010bl	11. Energy Cost Budget and Appendix G.	Provides rules for removing fan energy from efficiency metrics when modeling in ECB or Appendix G.	Neutral (whole building performance tradeoff method only).
58	90.1–2010bn	8. Power and 10. Other Equipment.	Establishes electric and fuel metering requirements	Neutral (metering by itself does not save energy).
59	90.1–2010bo	7. Service Water Heating.	Requires buildings with SWH capacity ≥ 1 million Btu/h to have average thermal efficiency of at least 90%. Updates Table 7.8 to reflect Federal requirements for electric water heaters. Updates the reference standard for swimming pool water heaters to ASHRAE Standard 146.	Minor + (requires large new gas SWH systems to have higher average efficiency).
60	90.1–2010bp	6. Heating, Ventilating, and Air-Conditioning and 12. Normative References.	Adds efficiency requirements (Btu/h-hp) to Table 6.8.1G (now Table 6.8.1–7 in Standard 90.1–2013) for evaporative condensers with ammonia refrigerants.	Minor + (adds efficiency requirements for new products).
61	90.1–2010bq	6. Heating, Ventilating, and Air-Conditioning and 3. Definitions.	Adds prescriptive requirements for the efficiency and improved control of commercial refrigeration systems.	Major + (adds new efficiency requirements for commercial refrigeration).
62	90.1–2010br	10. Other Equipment	Updates motor efficiency tables	Neutral (implements Federal standards).
63	90.1–2010bs	6. Heating, Ventilating, and Air-Conditioning.	Reduces occupancy threshold for demand controlled ventilation from greater than 40 people per 1000 ft ² to equal to or greater than 25 people per 1000 ft ² with exemptions for certain occupancies.	Minor + (reduces ventilation energy usage).
64	90.1–2010bt	6. Heating, Ventilating, and Air-Conditioning.	Reduces the system size and outdoor air thresholds at which energy recovery is required. (Relaxed in some climate zones.).	Minor + (expands the use of exhaust air energy recovery to lower percent outdoor air).
65	90.1–2010bv	5. Building Envelope	Reduces the area threshold at which skylights and daylighting controls are required.	Minor + (reduces lighting energy usage).
66	90.1–2010bw	5. Building Envelope and 11. Energy Cost Budget Method.	Modifies orientation requirements and adds solar heat gain coefficient tradeoff.	Minor + (provides design flexibility).

TABLE IV.1—QUALITATIVE ANALYSIS FINDINGS—Continued

Number	Addendum to standard 90.1–2010 ⁵	Sections affected within the standard	Description of changes	Impact on energy efficiency (justification)
67	90.1–2010bx	9. Lighting	Clarifies exceptions to occupancy sensor requirements	Neutral (clarification only).
68	90.1–2010by	9. Lighting	Significantly modifies the way requirements are presented in Section 9. Requires the use of certain lighting controls in more space types. Reduces the amount of time after occupants vacate a space for lights to be automatically reduced or shut off. Establishes table of lighting controls applicable to each space type.	Major + (requires more controls in more spaces and reduces time to reduction or shut-off).
69	2007 90.1bz	8. Power	Adds a Section 8.4.2, which specifies requirements for installation of basic electrical metering of major end uses (total electrical energy, HVAC systems, interior lighting, exterior lighting and receptacle circuits) to provide basic reporting of energy consumption data to building occupant.	Neutral (metering by itself does not save energy).
70	90.1–2010ca	6. Heating, Ventilating, and Air-Conditioning.	Adds control requirements for heating systems in vestibules ...	Minor + (reduces vestibule heating energy usage).
71	90.1–2010cb	6. Heating, Ventilating, and Air-Conditioning.	Revises night setback requirements to a reset of 10 °F heating and 5 °F cooling and removes exceptions for climate zones. Changes optimum start requirement from >10,000 cubic feet per minute to any DDC system and adds a requirement that outside air temperature be used in optimum algorithms.	Minor + (expands heating and cooling setbacks).
72	90.1–2010cc	6. Heating, Ventilating, and Air-Conditioning.	Adds efficiency requirements (Btu/h-hp) to Table 6.8.1G (now Table 6.8.1–7 in Standard 90.1–2013) for evaporative condensers with R–507A.	Minor + (adds efficiency requirements for new products).
73	90.1–2010cd	6. Heating, Ventilating, and Air-Conditioning, 7. Service Water Heating, and 3. Definitions.	Provides definition for “piping” to include all accessories in series with pipe such as pumps, valves, strainers, air separators, etc. This is meant to clarify that these accessories need to be insulated.	Neutral (editorial only).
74	90.1–2010ce	Appendix G	Establishes a baseline system type for retail occupancies less than three stories in Appendix G.	Neutral (whole building performance tradeoff method only).
75	90.1–2010cf	Appendix G	Establishes baseline window-to-wall ratio in Appendix G for strip malls.	Neutral (whole building performance tradeoff method only).
76	90.1–2010cg	11. Energy Cost Budget and Appendix G.	Modifies the simulation requirements for modeling mandatory automatic daylighting controls as well as automatic lighting controls. Also modifies the simulation requirements for automatic lighting controls in the proposed design, beyond the minimum mandatory requirements. Table G3.2, which provided power adjustment percentages for automatic lighting controls, has been deleted and savings through automatic control devices are now required to be modeled in building simulation through schedule adjustments for the proposed design or by lighting power adjustments defined in Table 9.6.3.	Neutral (whole building performance tradeoff method only).
77	90.1–2010ch	6. Heating, Ventilating, and Air-Conditioning.	Increases air- and water-cooled chiller efficiencies in Table 6.8.1C (now Table 6.8.1–3 in Standard 90.1–2013). Exempts water-cooled positive displacement chillers with leaving condenser temperature ≥ 115 °F (typically heat reclaim chillers).	Minor + (increases stringency of existing requirements).
78	90.1–2010ci	3. Definitions, 11. Energy Cost Budget, and Appendix G.	Modifies requirements for the cooling tower fans in Chapter 11 baseline simulations, from two-speed to variable speed. A formula has been specified to calculate the condenser water design supply temperature. Similar revisions have been made to Appendix G for the cooling tower requirements. Definitions for cooling design wet-bulb temperature and evaporation design wet-bulb temperature have been added to Chapter 3.	Neutral (whole building performance tradeoff method only).
79	90.1–2010cj	Appendix G	Creates modeling rules for computer rooms in Appendix G	Neutral (whole building performance tradeoff method only).

TABLE IV.1—QUALITATIVE ANALYSIS FINDINGS—Continued

Number	Addendum to standard 90.1–2010 ⁵	Sections affected within the standard	Description of changes	Impact on energy efficiency (justification)
80	90.1–2010ck	6. Heating, Ventilating, and Air-Conditioning.	Requires VAV dual maximum damper position when DDC system is present and clarifies dual maximum sequence.	Minor + (requires dual maximum control for VAV zones with DDC.
81	90.1–2010cl	6. Heating, Ventilating, and Air-Conditioning.	Increases integrated energy efficiency ratio requirements for air-cooled air conditioners and heat pumps and EER requirements for water and evaporatively cooled air conditioners and heat pumps in Tables 6.8.1A and B (now Tables 6.8.1–1 and 6.8.1–2 in Standard 90.1–2013).	Minor + (increases stringency of existing requirements).
82	90.1–2010cm	5. Building Envelope	Clarifies how to interpret the use of dynamic glazing products given the requirements in Addendum bb (envelope requirements).	Neutral (clarification only).
83	90.1–2010cn	Appendix G	Establishes modeling rules for laboratories with 100% outside air in Appendix G.	Neutral (whole building performance tradeoff method only).
84	90.1–2010co	9. Lighting	Comprehensive update of LPDs in Table 9.5.1—Building Area Method.	Major + (decreases LPD in most building types).
85	90.1–2010cp	5. Building Envelope	Corrects non-residential U-factor and R value requirements for steel joist floors in CZ3.	Minor + (increases R value requirements for steel joist floors).
86	90.1–2010cr	9. Lighting and 12. Normative References.	Makes a number of adjustments to Table 9.6.1, Space-by-space LPD.	Minor + (plus on retail outweighs some negatives on other building types).
87	90.1–2010ct	Appendix G	Identifies heated only storage systems 9 and 10 in Appendix G as being assigned one system per thermal zone.	Neutral (whole building performance tradeoff method only).
88	90.1–2010cv	Appendix G	Establishes baseline system types in Appendix G for Assembly occupancies.	Neutral (whole building performance tradeoff method only).
89	90.1–2010cy	6. Heating, Ventilating, and Air-Conditioning.	Reduces the design supply fan air flow rate for which energy recovery is required for systems that operate more than 8,000 hours per year.	Minor + (applies energy recovery requirements to smaller fan systems).
90	90.1–2010cz	6. Heating, Ventilating, and Air-Conditioning.	Increases boiler efficiency for residential sized (National Appliance Energy Conservation Act covered) equipment, <3,000 Btu/h.	Neutral (adopts Federal standards).
91	90.1–2010da	5. Building Envelope	Relaxes air leakage requirements for high-speed doors for vehicle access and material transport.	Minor—(relaxes air leakage requirements for high-speed doors).
92	90.1–2010db	5. Building Envelope	Corrects residential U-factor and R-value requirements for steel joist floors in CZ3.	Minor—(relaxes steel joist floor requirements in CZ3).
93	90.1–2010dc	9. Lighting	Clarifies automatic lighting and switched receptacle control in guest rooms as applied to individual spaces.	Neutral (clarification only).
94	90.1–2010dd	5. Building Envelope and 3. Definitions.	Clarifies roof insulation requirements, differentiating between roof recovering (on top of existing roof covering) and replacement of roof covering.	Neutral (clarification only).
95	90.1–2010de	6. Heating, Ventilating, and Air-Conditioning.	Relaxes design requirements for waterside economizers for computer rooms.	Minor—(relaxes economizer requirements for computer rooms).
96	90.1–2010dg	12. Normative References (related to 5. Building Envelope).	Updates reference to ANSI/CRRC—I Standard 2012 (cool roof ratings).	Neutral (updates references only).
97	90.1–2010di	6. Heating, Ventilating, and Air-Conditioning.	Establishes limits on using electric or fossil fuel to humidify or dehumidify between 30% and 60% relative humidity except certain applications. Requires deadband on humidity controls.	Minor + (reduces humidification energy usage).

TABLE IV.1—QUALITATIVE ANALYSIS FINDINGS—Continued

Number	Addendum to standard 90.1–2010 ⁵	Sections affected within the standard	Description of changes	Impact on energy efficiency (justification)
98	90.1–2010dj	9. Lighting	Additional lighting power allowance for electrical/mechanical rooms made available to match 2010 level provided there is separate control for the additional lighting.	Neutral (tradeoff of additional lighting power for additional control).
99	90.1–2010dk	9. Lighting	Eliminates the exemption for wattage used in spaces where lighting is specifically designed for those with age-related eye conditions or other medical conditions related to the eye, where special lighting or light levels might be needed.	Minor + (trades blanket exemption for more targeted LPD increases).
100	90.1–2010dl	9. Lighting	Modifies hotel and motel guest room LPD	Minor + (new average LPD less than previous requirements).
101	90.1–2010dm	5. Building Envelope	Modifies Section 5.4.3.4 for vestibules. Adds a size limit for large buildings, exemptions for semi-heated spaces and elevator lobbies in parking garages.	Minor + (reduces vestibule energy usage).
102	90.1–2010dn	6. Heating, Ventilating, and Air-Conditioning.	Reduces the limits on hot gas bypass as a means of cooling capacity control.	Minor + (reduces hot gas bypass).
103	90.1–2010do	12. Normative References (related to 6. Heating, Ventilating, and Air-Conditioning).	Updates references to AHRI 550, AMCA 500, ANSI Z21.10.3 and Z21.47, ASHRAE 90.1 and 62.1, NEMA MG 1, and NFPA 70 and 96.	Neutral (updates references only).
104	90.1–2010dp	3. Definitions (related to 6. Heating, Ventilating, and Air-Conditioning).	Corrects the definition of walk-in-cooler to be consistent with Federal requirements.	Neutral (editorial only).
105	90.1–2010dq	6. Heating, Ventilating, and Air-Conditioning.	Deletes sizing requirements for pipes >24" in diameter	Minor—(eliminates sizing requirements for pipes above 24" in diameter).
106	90.1–2010dr	3. Definitions (related to 5. Building Envelope).	Clarifies definition of building entrances to exclude electrical room, mechanical rooms, and other utility service entrances.	Neutral (clarification only).
107	90.1–2010ds	5. Building Envelope and 3. Definitions.	Revises the definitions of "primary sidelighted area," "secondary sidelighted area," and "sidelighting effective area" to use the term "vertical fenestration" instead of "window" to clarify that glazed doors and other fenestration products are included as well as windows. Additionally, the definition of "daylight area under rooftop monitors" is corrected to include the spread of light beyond the width of the rooftop monitor glazing.	Neutral (editorial only).
108	90.1–2010dt	9. Lighting	Adds exceptions for control of exterior lighting integral to signage. Requires certain types of exterior lighting exempt from LPD requirements to be separately controlled.	Minor + (expansion of requirement to all signage may outweigh addition of exception).
109	90.1–2010dv	6. Heating, Ventilating, and Air-Conditioning.	Establishes chiller and boiler fluid flow isolation requirements so there is no flow through the equipment when not in use.	Minor + (reduces off hour chiller and boiler energy use).
110	90.1–2010dw	6. Heating, Ventilating, and Air-Conditioning.	Revises high limit shutoff for air economizers. Add sensor accuracy requirements.	Minor + (adds sensor accuracy requirements).

KEY: The following terms are used to characterize the effect of individual addenda on energy efficiency (as contained in the above table): *Major +* indicates that an addendum is anticipated to significantly improve energy efficiency; *Minor +* indicates that an addendum may improve energy

efficiency in specific applications, *Neutral* indicates that an addenda is not anticipated to impact energy efficiency; and *Minor –* indicates that an addendum may increase energy use in certain applications.

Table IV.2 summarizes the overall impact of the addenda in the qualitative

analysis. Overall, the sum of the major positive and minor positive addenda (*i.e.*, 52 addenda) greatly overwhelms the number of minor negative addenda (*i.e.*, five addenda), leading to the qualitative conclusion that the overall impact of the addenda on the Standard is positive.

⁵ Addenda as designated by ASHRAE and included in Standard 90.1–2013.

TABLE IV.2—OVERALL SUMMARY OF ADDENDA IMPACT IN QUALITATIVE ANALYSIS

Major negative	Minor negative	Neutral	Minor positive	Major positive	Total
None	5	53	44	8	110

Quantitative Analysis

The quantitative analysis of Standard 90.1–2013 was carried out using whole-building energy simulations of buildings designed to meet the requirements of Standard 90.1–2010 and Standard 90.1–2013. DOE simulated 16 representative building types across 15 U.S. climate locations, with locations selected to be representative of all U.S. climate zones, as defined by Standard 90.1–2010 and Standard 90.1–2013 (climate zone criteria unchanged between the 2010 and 2013 editions). In addition, energy use intensities (EUIs) by fuel type and by end-use were extracted for each building type, and weighted by the relative square footage of construction (represented by that building type in each of the 15 climate regions) based on the McGraw Hill Construction (MHC) Projects Starts Database.⁶ The data is commonly used by other Federal

agencies, such as the U.S. Census Bureau, the Federal Reserve, and the U.S. Department of Health and Human Services (HHS), to characterize U.S. building construction. In addition, the MHC database identifies multi-family residential buildings that would be covered under the scope of Standard 90.1.

EUIs developed for each representative building type are weighted by total national square footage of each representative building type to estimate the difference between the national energy use in buildings constructed to the 2010 and 2013 editions of Standard 90.1. Note that the buildings types used in the quantitative analysis reflect approximately 80% of the total square footage of commercial construction, including multi-family buildings greater than three stories that are covered within the scope of ASHRAE Standard 90.1.

The quantitative analysis of buildings designed to meet the requirements of Standard 90.1–2013 indicates national primary energy savings of approximately 8.5 percent of commercial building energy consumption (in comparison to Standard 90.1–2010). Site energy savings over Standard 90.1–2010 are estimated to be approximately 7.6 percent. Using national average fuel prices for electricity and natural gas, DOE also estimates a reduction in energy expenditures of 8.7 percent compared to Standard 90.1–2010.

Table IV.3 and Table IV.4 show the energy use and associated savings resulting from Standard 90.1–2013 by building type and on an aggregated national basis. Further details on the quantitative analysis can be found in the full technical support document (TSD)⁷ available at <http://www.energycodes.gov/regulations/determinations>.

TABLE IV.3—ESTIMATED ENERGY USE INTENSITY BY BUILDING TYPE (STANDARD 90.1–2010)

Building type	Prototype	Floor area (percent)	Whole building EUI		
			Site EUI (kBtu/ft ² -yr)	Source EUI (kBtu/ft ² -yr)	ECI (\$/ft ² -yr)
Office	Small Office	5.61	33.0	100.4	\$0.99
	Medium Office	6.05	36.8	105.9	1.03
	Large Office	3.33	71.9	210.7	2.06
Retail	Stand-Alone Retail	15.25	53.4	142.9	1.38
	Strip Mall	5.67	60.4	164.1	1.58
Education	Primary School	4.99	59.0	151.1	1.44
	Secondary School	10.36	47.7	130.3	1.26
Healthcare	Outpatient Health Care	4.37	120.0	324.3	3.13
	Hospital	3.45	131.0	321.1	3.04
Lodging	Small Hotel	1.72	63.6	148.8	1.40
	Large Hotel	4.95	96.7	217.7	2.03
Warehouse	Non-Refrigerated Warehouse	16.72	18.2	43.2	0.41
Food Service	Fast-Food Restaurant	0.59	591.5	1051.7	9.27
	Sit-Down Restaurant	0.66	383.9	742.7	6.69
Apartment	Mid-Rise Apartment	7.32	46.3	131.4	1.28
	High-Rise Apartment	8.97	50.4	124.9	1.19
National		100	58.5	148.9	1.42

TABLE IV.4—ESTIMATED ENERGY USE INTENSITY BY BUILDING TYPE (STANDARD 90.1–2013)

Building type	Prototype	Floor area (percent)	Whole building EUI		
			Site EUI (kBtu/ft ² -yr)	Source EUI (kBtu/ft ² -yr)	ECI (\$/ft ² -yr)
Office	Small Office	5.61	29.4	89.3	\$0.88

⁶ Based on McGraw Hill Construction Projects Starts Database; see *Weighting Factors for the Commercial Building Prototypes Used in the Development of ANSI/ASHRAE/IESNA Standard 90.1–2010* by Jarnagin, RE and GK Bandyopadhyay. 2010. PNNL–19116, Pacific Northwest National

Laboratory, Richland, WA. Available at http://www.pnl.gov/main/publications/external/technical_reports/PNNL-19116.pdf.

⁷ Halverson et al., *ANSI/ASHRAE/IES Standard 90.1–2013 Determination of Energy Savings*:

Quantitative Analysis (PNNL, Richland, WA (US), July 2014), available at http://www.pnnl.gov/main/publications/external/technical_reports/pnnl-23479.pdf.

TABLE IV.4—ESTIMATED ENERGY USE INTENSITY BY BUILDING TYPE (STANDARD 90.1–2013)—Continued

Building type	Prototype	Floor area (percent)	Whole building EUI		
			Site EUI (kBtu/ft ² -yr)	Source EUI (kBtu/ft ² -yr)	ECI (\$/ft ² -yr)
Retail	Medium Office	6.05	34.1	97.9	0.95
	Large Office	3.33	70.8	205.8	2.01
	Stand-Alone Retail	15.25	45.9	124.6	1.20
	Strip Mall	5.67	55.1	147.3	1.42
Education	Primary School	4.99	54.2	134.4	1.28
	Secondary School	10.36	41.7	111.9	1.08
Healthcare	Outpatient Health Care	4.37	115.8	311.8	3.00
	Hospital	3.45	123.7	300.7	2.85
Lodging	Small Hotel	1.72	60.0	137.6	1.29
	Large Hotel	4.95	89.0	195.4	1.81
Warehouse	Non-Refrigerated Warehouse	16.72	17.1	40.6	0.38
Food Service	Fast-Food Restaurant	0.59	576.4	1001.9	8.78
	Sit-Down Restaurant	0.66	372.5	713.5	6.41
Apartment	Mid-Rise Apartment	7.32	43.9	124.8	1.21
	High-Rise Apartment	8.97	46.9	114.4	1.08
National		100	54.1	136.2	1.30

Table IV.5 presents the estimated energy savings (based on percent change in EUI) associated with Standard 90.1–

2013. Overall, the updated Standard is expected to increase the energy

efficiency of commercial buildings, as represented in Table IV.5.

TABLE IV.5—QUANTITATIVE ANALYSIS FINDINGS

Building type	Prototype	Floor area (percent)	Savings in whole-building EUI (percent)		
			Site EUI	Source EUI	ECI
Office	Small Office	5.61	11.0	11.0	11.0
	Medium Office	6.05	7.4	7.5	7.5
	Large Office	3.33	1.4	2.4	2.5
Retail	Stand-Alone Retail	15.25	13.9	12.8	12.6
	Strip Mall	5.67	8.8	10.2	10.5
Education	Primary School	4.99	8.1	11.0	11.5
	Secondary School	10.36	12.6	14.1	14.4
Healthcare	Outpatient Health Care	4.37	3.6	3.9	3.9
	Hospital	3.45	5.6	6.4	6.5
Lodging	Small Hotel	1.72	5.7	7.5	7.9
	Large Hotel	4.95	8.0	10.2	10.7
Warehouse	Non-Refrigerated Warehouse	16.72	6.0	6.1	6.1
Food Service	Fast Food Restaurant	0.59	2.6	4.7	5.3
	Sit-Down Restaurant	0.66	3.0	3.9	4.2
Apartment	Mid-Rise Apartment	7.32	5.4	5.1	5.0
	High-Rise Apartment	8.97	6.9	8.4	8.7
National		100	7.6	8.5	8.7

V. Determination Statement

Review and evaluation of the 2010 and 2013 editions of Standard 90.1 indicate that there are significant differences between the two editions. Qualitative analysis of the updated Standard reveals that a majority of the addenda are anticipated to result in significant energy savings. In addition, quantitative analysis of the Standard indicates source and site energy savings of 8.5 percent and 7.6 percent, respectively. DOE has rendered the conclusion that Standard 90.1–2013 will improve energy efficiency in

commercial buildings, and, therefore, receives an affirmative determination under Section 304(b) of ECPA.

VI. State Certification

Upon publication of this affirmative determination, each State is required to review and update, as necessary, the provisions of its commercial building energy code to meet or exceed the provisions of the 2013 edition of Standard 90.1. (42 U.S.C. 6833(b)(2)(B)(i)) This action is required not later than 2 years from the date the final Notice of Determination is

published in the **Federal Register**, unless an extension is provided.

State Review & Update

DOE recognizes that some States do not have a State commercial building energy code, or have a State code that does not apply to all commercial buildings. If local building energy codes regulate commercial building design and construction (rather than a State code), the State must review and make all reasonable efforts to update, as authorized, those local codes to determine whether they meet or exceed the 2013 edition of Standard 90.1. States

may base their certifications on reasonable actions by units of general-purpose local government. Each such State must review the information obtained from the local governments, and gather any additional data and testimony in preparing its own certification.

The applicability of any State revisions to new or existing buildings would be governed by the State building codes. States should be aware that the DOE considers high-rise (greater than three stories) multi-family residential buildings as commercial buildings for energy code purposes, as is consistent with the scope of Standard 90.1. Consequently, commercial buildings, for the purposes of certification, would include high-rise multi-family residential buildings, hotels, motels, and other transient residential building types of any height.

State Certification Statements

Section 304(b) of ECPA, as amended, requires each State to certify to the Secretary of Energy that it has reviewed and updated the provisions of its commercial building energy code regarding energy efficiency to meet or exceed the Standard 90.1–2013. (42 U.S.C. 6833(b)) The certification must include a demonstration that the provisions of the State's commercial building energy code regarding energy efficiency meets or exceeds Standard 90.1–2013. If a State intends to certify that its commercial building energy code already meets or exceeds the requirements of Standard 90.1–2013, the State should provide an explanation of the basis for this certification (e.g., Standard 90.1–2013 is incorporated by reference in the State's building code regulations). The chief executive of the State (e.g., the governor), or a designated State official (e.g., director of the State energy office, State code commission, utility commission, or equivalent State agency having primary responsibility for commercial building energy codes), would provide the certification to the Secretary. Such a designated State official would also provide the certifications regarding the codes of units of general purpose local government based on information provided by responsible local officials.

The DOE Building Energy Codes Program tracks and reports State code adoption and certifications.⁸ Once a State has adopted a new commercial code, DOE typically provides software, training, and support for the new code as long as the new code is based on the

national model code (i.e., ASHRAE Standard 90.1–2013). DOE has issued previous guidance on how it intends to respond to technical assistance requests related to implementation resources, such as building energy code compliance software. (79 FR 15112) DOE also recognizes that some States develop their own codes that are only loosely related to the national model codes, and DOE does not typically provide technical support for those codes. However, DOE does provide incentive funding (e.g., grants) to these States through various means, such as the State Energy Program. DOE does not prescribe how each State adopts and enforces its energy codes.

Requests for Extensions

Section 304(c) of ECPA requires that the Secretary permit an extension of the deadline for complying with the certification requirements described above, if a State can demonstrate that it has made a good faith effort to comply with such requirements and that it has made significant progress toward meeting its certification obligations. (42 U.S.C. 6833(c)) Such demonstrations could include one or both of the following: (1) a plan for response to the requirements stated in Section 304; or (2) a statement that the State has appropriated or requested funds (within State funding procedures) to implement a plan that would respond to the requirements of Section 304 of ECPA. This list is not exhaustive. Requests are to be sent to the address provided in the **ADDRESSES** section above, or may be submitted to BuildingEnergyCodes@ee.doe.gov.

VII. Regulatory Review & Analysis

Review Under Executive Orders 12866 and 13563

Today's action is not a significant regulatory action under Section 3(f) of Executive Order 12866, "Regulatory Planning and Review" (58 FR 51735). Accordingly, today's action was not reviewed by the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB). DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011. (76 FR 3281). Executive Order 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866.

Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires the

preparation of an initial regulatory flexibility analysis for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, "Proper Consideration of Small Entities in Agency Rulemaking" (67 FR 53461), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. (68 FR 7990) DOE has also made its procedures and policies available on the Office of General Counsel Web site.⁹

DOE has reviewed today's determination under the provisions of the Regulatory Flexibility Act and the procedures and policies published in February 2003. As part of this determination of improved energy efficiency, section 304 of ECPA requires States to undertake an assessment of their respective building codes. As such, the only entities directly regulated by this determination would be States. DOE does not believe that there will be any direct impacts on small entities, such as small businesses, small organizations, or small governmental jurisdictions.

Based on the foregoing, DOE certifies that this determination would not have a significant economic impact on a substantial number of small entities. Accordingly, DOE has not prepared a regulatory flexibility analysis for this determination. DOE's certification and supporting statement of factual basis will be provided to the Chief Counsel for Advocacy of the Small Business Administration pursuant to 5 U.S.C. 605(b).

Review Under the National Environmental Policy Act of 1969

Today's action is covered under the Categorical Exclusion found in DOE's National Environmental Policy Act regulations at paragraph A.6 of appendix A to subpart D, 10 CFR part 1021. That Categorical Exclusion applies to actions that are strictly procedural, such as rulemaking establishing the administration of grants. Today's action is required by Title III of ECPA, as amended, which provides that whenever the Standard 90.1–1989, or any successor to that code, is revised, the Secretary must make a determination, not later than 12 months after such revision, whether the revised code would improve energy

⁸ Available at <http://www.energycodes.gov/adoption/states>.

⁹ Available at <http://energy.gov/gc/office-general-counsel>.

efficiency in commercial buildings and must publish notice of such determination in the **Federal Register**. (42 U.S.C. 6833(b)(2)(A)) If the Secretary determines that the revision of Standard 90.1–1989, or any successor thereof, improves the level of energy efficiency in commercial buildings, then no later than 2 years after the date of the publication of such affirmative determination, each State is required to certify that it has reviewed and updated the provisions of its commercial building code regarding energy efficiency with respect to the revised or successor code. (42 U.S.C. 6833(b)(2)(B)(i)) If the Secretary makes a determination that the revised Standard will not improve energy efficiency in commercial buildings, then State commercial codes shall meet or exceed the last revised Standard for which the Secretary has made a positive determination. (42 U.S.C. 6833(b)(2)(B)(ii)) Therefore, DOE has preliminarily determined that the Secretary's determination is not a major Federal action that would have direct environmental impacts. Accordingly, DOE has not prepared an environmental assessment or an environmental impact statement.

Review Under Executive Order 13132, "Federalism"

Executive Order 13132 (64 FR 43255) imposes certain requirements on agencies formulating and implementing policies or regulations that pre-empt State law or that have federalism implications. Agencies are required to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and carefully assess the necessity for such actions. DOE has reviewed the statutory authority, and Congress found that:

(1) Large amounts of fuel and energy are consumed unnecessarily each year in heating, cooling, ventilating, and providing domestic hot water for newly constructed residential and commercial buildings because such buildings lack adequate energy conservation features;

(2) Federal voluntary performance standards for newly constructed buildings can prevent such waste of energy, which the Nation can no longer afford in view of its current and anticipated energy shortage;

(3) The failure to provide adequate energy conservation measures in newly constructed buildings increases long-term operating costs that may affect adversely the repayment of, and security for, loans made, insured, or guaranteed by Federal agencies or made by

federally insured or regulated instrumentalities; and

(4) State and local building codes or similar controls can provide an existing means by which to ensure, in coordination with other building requirements and with a minimum of Federal interference in State and local transactions, that newly constructed buildings contain adequate energy conservation features. (42 U.S.C. 6831)

Pursuant to Section 304(b) of ECPA, DOE is statutorily required to determine whether the most recent edition of Standard 90.1 would improve the level of energy efficiency in commercial buildings as compared to the previous edition. If DOE makes a positive determination, the statute requires each State to certify that it has reviewed and updated the provisions of its commercial building code regarding energy efficiency with respect to the revised or successor codes. (42 U.S.C. 6833(b)(2)(B)(i))

Executive Order 13132 requires meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications unless funds necessary to pay the direct costs incurred by the State and local governments in complying with the regulation are provided by the Federal Government. (62 FR 43257) Pursuant to Section 304(e) of ECPA, the DOE Secretary is required to provide incentive funding to States to implement the requirements of section 304, and to improve and implement State residential and commercial building energy efficiency codes, including increasing and verifying compliance with such codes. In determining whether, and in what amount, to provide incentive funding, the Secretary must consider the actions proposed by the State to implement the requirements of this section, to improve and implement residential and commercial building energy efficiency codes, and to promote building energy efficiency through the use of such codes. (See 42 U.S.C. 6833(e)) Therefore, consultation with States and local officials regarding this determination was not required.

However, DOE notes that State and local governments were invited to participate in the development Standard 90.1–2013. The ASHRAE Standard is developed in a national, ANSI-approved consensus process open to the public, and in which State and local governments may participate, along with the general public. The updated Standard is the product of a series of amendments to the prior edition of the Standard, with each addendum made available for public review with any

interested party having the ability to submit comments. Comments on the addendum are received, reviewed, and resolved through an established process commonly utilized in generating industry consensus standards. Members of the Standard 90.1 project committee have included representatives of State and local governments. DOE believes that this process has given State and local jurisdictions extensive opportunity to comment and express any concerns on Standard 90.1–2013, the subject of this determination.

On issuance of a determination that Standard 90.1–2013 would improve the energy efficiency of commercial buildings, ECPA requires each State to certify to the Secretary that it has reviewed and updated the provisions of its commercial building code regarding energy efficiency to meet or exceed the requirements of Standard 90.1–2013. DOE notes that ECPA sets forth this requirement for States. (42 U.S.C. 6833(b)(2)(B)(i)) States are given broad freedom to either adopt Standard 90.1–2013 or develop their own code that meets or exceeds Standard 90.1–2013.

Review Under Unfunded Mandates Reform Act of 1995

The Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) generally requires Federal agencies to examine closely the impacts of regulatory actions on State, local, and tribal governments. Subsection 101(5) of Title I of that law defines a Federal intergovernmental mandate to include any regulation that would impose upon State, local, or tribal governments an enforceable duty, except a condition of Federal assistance or a duty arising from participating in a voluntary Federal program. Title II of that law requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and tribal governments, in the aggregate, or to the private sector, other than to the extent such actions merely incorporate requirements specifically set forth in a statute. Section 202 of that title requires a Federal agency to perform an assessment of the anticipated costs and benefits of any rule that includes a Federal mandate that may result in costs to State, local, or tribal governments, or to the private sector, of \$100 million or more. Section 204 of that title requires each agency that proposes a rule containing a significant Federal intergovernmental mandate to develop an effective process for obtaining meaningful and timely input from elected officers of State, local, and tribal governments.

Consistent with previous determinations, DOE has completed its

review, and concluded that impacts on state, local and tribal governments are less than the \$100 million threshold specified in the Unfunded Mandates Act. Accordingly, no further action is required under the Unfunded Mandates Reform Act of 1995. Documentation supporting this review is contained in Appendix D of the Quantitative Analysis technical support document (TSD) ¹⁰ available at <http://www.energycodes.gov/regulations/determinations>.

Review Under the Treasury and General Government Appropriations Act of 1999

Section 654 of the Treasury and General Government Appropriations Act of 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. Today's action would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

Review Under the Treasury and General Government Appropriations Act of 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by the Office of Management and Budget (OMB). Both OMB and DOE have published established relevant guidelines (67 FR 8452 and 67 FR 62446, respectively). DOE has reviewed today's action under the OMB and DOE guidelines, and has concluded that it is consistent with applicable policies in those guidelines.

Review Under Executive Order 13211

Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use," (66 FR 28355), requires Federal agencies to prepare and submit to the OMB a Statement of Energy Effects for any proposed significant energy action. A "significant energy action" is defined as any action by an agency that promulgated or is expected to lead to promulgation of a final rule, and that: (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2)

is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of the OMB Office of Information and Regulatory Affairs (OIRA) as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use, should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use. Today's action would not have a significant adverse effect on the supply, distribution, or use of energy and is therefore not a significant energy action. Accordingly, DOE has not prepared a Statement of Energy Effects.

Review Under Executive Order 13175

Executive Order 13175, "Consultation and Coordination with Indian tribal Governments" (65 FR 67249), requires DOE to develop an accountable process to ensure "meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications." "Policies that have tribal implications" refers to regulations that have "substantial direct effects on one or more Indian tribes, on the relationship between the Federal Government and Indian tribes, or on the distribution of power and responsibilities between the Federal Government and Indian tribes." Today's action is not a policy that has "tribal implications" under Executive Order 13175. DOE has reviewed today's action under Executive Order 13175 and has determined that it is consistent with applicable policies of that Executive Order.

Issued in Washington, DC, on September 18, 2014.

Kathleen B. Hogan,

Deputy Assistant Secretary for Energy Efficiency, Energy Efficiency and Renewable Energy.

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DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy

[EERE–2014–BT–DET–0030]

RIN 1904–AD33

Preliminary Determination Regarding Energy Efficiency Improvements in the 2015 International Energy Conservation Code

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

ACTION: Notice of Preliminary Determination.

SUMMARY: The U.S. Department of Energy (DOE) has preliminarily determined that the 2015 edition of the International Energy Conservation Code (IECC) would improve energy efficiency in buildings subject to the code compared to the 2012 edition. DOE analysis indicates that buildings meeting the 2015 IECC (as compared with buildings meeting the 2012 IECC) would result in national source energy savings of approximately 1.03 percent, site energy savings of approximately 1.12 percent, and energy cost savings of approximately 0.90 percent of residential building energy consumption, as regulated by the IECC. If this determination is finalized, each State would be required by statute to certify that it has reviewed the provisions of its residential building code regarding energy efficiency, and made a determination as to whether to update their code to meet or exceed the 2015 IECC. Additionally, this notice provides guidance to States on these processes and associated certifications.

DATES: Comments must be provided by October 27, 2014.

ADDRESSES: Any comments submitted must identify docket number EERE–2014–BT–DET–0030 or Regulatory Information Number (RIN) 1904–AD33. Comments may be submitted using any of the following methods:

1. *Federal eRulemaking Portal:* www.Regulations.gov. Follow the instructions for submitting comments.

2. *Email:* 2015IECC2014DET0030@ee.doe.gov. Include the docket number and/or RIN in the subject line of the message.

3. *Mail:* Ms. Brenda Edwards; U.S. Department of Energy, Building Technologies Office EE–5B; 1000 Independence Avenue SW., Washington, DC 20585. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

¹⁰ Halverson et al., *ANSI/ASHRAE/IES Standard 90.1–2013 Determination of Energy Savings: Quantitative Analysis* (PNNL, Richland, WA (US), June 2014), available at http://www.pnnl.gov/main/publications/external/technical_reports/pnnl-23479.pdf.