Inflation Reduction Act of 2022 (IRA)
Assistance for the Adoption of the Latest and Zero Building Energy Codes Funding Opportunity Announcement (FOA): Equivalency Methodology Supporting Funding Eligibility for Section 50131 of the IRA

Section 1: Introduction

Section 50131 of the Inflation Reduction Act (IRA)[1] makes the following investments to assist States and units of local government with authority to adopt building codes:

- Up to $330 million to adopt and implement the latest building energy code(s) that meets or exceeds the energy savings in the 2021 International Energy Conservation Code (IECC) for residential buildings and the ANSI/ASHRAE/IES Standard 90.1–2019 for commercial buildings; and
- Up to $670 million to adopt and implement a building energy code (or codes) that meets or exceeds the zero energy provisions in the 2021 IECC code or an equivalent stretch code.

The following document describes the methodologies for determining the equivalency of a proposed building energy code as compared to the relevant building energy code specified in Section 50131 to meet the requirements of Funding Opportunity Announcement (FOA) Number DE-FOA-0003056:[2] As provided in the FOA, eligible building codes must be measurable, verifiable, and enforceable.

Section 2: Determining Equivalence

Equivalence is determined based on whether the Applicant's proposed building energy code delivers equivalent or greater energy savings relative to the code category represented by the Topic Area and Subtopic Area selected for submission. The four code categories relative to which equivalence must be calculated are described in Table 1, below.

[1] https://www.congress.gov/bill/117th-congress/house-bill/5376/text
[2] https://infrastructure-exchange.energy.gov/Default.aspx

Table 1: Equivalence Categories and Comparison Descriptions

Equivalence Category	Equivalence Comparison
Residential Latest Model Code (LMC)	Savings for the proposed code are compared against savings that would be achieved by adopting the 2021 IECC unamended
Commercial LMC	Savings for the proposed code are compared against savings that would be achieved by adopting ASHRAE 90.1-2019 unamended
Residential Zero Energy Code (ZEC)	Savings for the proposed code are compared against savings what would be achieved by adopting Appendix RC of the 2021 IECC
Commercial ZEC	Savings from the proposed code are compared against savings what would be achieved by adopting Appendix CC of the 2021 IECC

The Topic and Subtopic Areas summarized in the FOA[3] have specific equivalency calculation requirements as noted in Table 2, below.

Table 2: Equivalence Requirements for FOA Topic and Subtopic Areas

FOA Topic and Subtopic Area	Description	Equivalence Requirements
Topic Area 1 Subtopic A and B	Adoption of Qualifying Building Energy Codes for Units of Local Government	No equivalence calculation is required. Document any proposed strengthening and/or neutral amendments (see Topic Area 1 Checklist).[4]
Topic Area 2 Subtopic A and B	Custom Versions of the LMC, including LMC with amended with combinations of strengthening and weakening amendments	Demonstrate equivalence as specified in Section 4 of this document.
Topic Area 2 Subtopic C and D	Custom Versions of the ZEC, including ZEC with amended with combinations of strengthening and weakening amendments	Demonstrate equivalence as specified in Section 4 of this document.
Topic Area 3 Subtopic A and B	Innovative Code Approaches Such as Building Performance Standards	Demonstrate equivalence as specified in Section 4 or Section 5 of this document, as appropriate.

Eligible jurisdictions with amendments or addenda that include only clarifications, administrative changes, and/or updated references to other documents should follow

[3] https://infrastructure-exchange.energy.gov/Default.aspx
[4] https://infrastructure-exchange.energy.gov/Default.aspx

submission requirements for Topic Area 1 and submit the fillable form as supporting documentation.

Examples of deciding which methodology applies to an Applicant's proposed code follow:

- If an Applicant is proposing a residential code with a combination of more and less stringent amendments compared with the 2021 IECC, but one that is not a zero energy code, they would need to submit an application under Topic Area 2, Subtopic A or B, with an equivalency calculation using Section 4 of this methodology to compare the proposed code to the 2021 IECC (Residential LMC). This will determine if the proposed code would deliver equivalent or greater energy savings compared to adopting the 2021 IECC unamended and is therefore a qualifying code under this funding opportunity.
- Similarly, a jurisdiction proposing to adopt and implement an innovative building energy code like a building performance standard (BPS) with a long-term goal similar to a zero energy code, would submit an application under Topic Area 3, Subtopic A or B, with an equivalency calculation using Section 5 of this methodology or a completed equivalency calculator[5] comparing the proposed BPS to the 2021 IECC Appendix CC (Commercial ZEC). This will determine whether the BPS would deliver equivalent or greater energy savings compared to adopting the 2021 IECC Appendix CC, and is therefore a qualifying code under this funding opportunity.

Energy savings for equivalency are evaluated based on the cumulative 30-year site energy savings calculated for the adoption and implementation of the statutory LMC or ZEC over the Applicant's current code, compared with the calculated cumulative 30-year site energy savings for the adoption and implementation of the proposed amended or innovative building energy code.

Applicants submitting proposals to Topic Area 2 and non-commercial/multifamily BPS proposals to Topic Area 3 may submit the specified input requirements provided in Section IV(D)(vi) of the FOA along with the full application. DOE will conduct the analysis in line with the methodology below to determine application eligibility following submission. Topic Area 3 proposals for innovative approaches to building energy codes for existing commercial and/or multifamily buildings must use the calculator provided and include it with the application at the time of submission.

Section 3: Equivalency Calculation Requirements

3.1 Energy Modeling Software Tool Technical Requirements

The energy modeling software utilized for the exercise must meet or exceed the technical requirements provided in this section, which are based on the requirements of ASHRAE 90.1-2019 and the 2021 IECC:

- The simulation program must model hourly whole-building energy consumption over an entire year (8760 hours per year);
- The simulation program must model all of the provisions and amendments of the proposed code under consideration and the comparable baseline code for

[5] https://infrastructure-exchange.energy.gov/Default.aspx

determining the anticipated energy consumption. Both the baseline and the proposed code provisions must be analyzed using identical methods and techniques;

- The simulation program must utilize hourly climatic data for the geographic location under consideration in modeling. For eligible jurisdictions with more than one climate zone, separate models must be created in each climate zone and results must be weighted by the expected construction volume and/or covered building stock, as applicable, in each climate zone to determine eligible jurisdictional averages;
- Example programs include, but are not limited to, EnergyPlus and DOE-2; and
- All other software requirements per ASHRAE 90.1-2019 and/or the 2021 IECC as applicable.

3.2 Required Inputs: Source Data and Energy Models

The following data sources are required to be used as part of the equivalence calculation:

1. Energy & Emissions
    a. Efficiency Category of Current Code: https://www.energycodes.gov/state-portal
    b. Energy Performance of Current Code: https://www.energycodes.gov/ira-codes-equivalence-methodology-inputs
    c. Prototype Building Models: https://www.energycodes.gov/prototype-building-models
    d. Greenhouse Gas (GHG) Emissions Factors: See Exhibit A of this document
2. Construction & Population
    a. Document data sources and assumptions used by DOE and must be used by the applicant for this analysis, including those referenced in:
        i. Impacts of Model Building Energy Codes – Interim Update: https://www.energycodes.gov/sites/default/files/2021-07/Impacts_of_Model_Energy_Codes_2010-2040_Interim_Update_07182021.pdf
        ii. New Construction Weighting Factors by State and Climate Zone: https://www.energycodes.gov/ira-codes-equivalence-methodology-inputs
    b. 2020 Census: https://www.census.gov/data/tables/time-series/demo/popest/2020s-total-cities-and-towns.html

Section 4: Methodology for Determining Equivalence for Custom or Innovative New Construction and Major Renovation Code(s) to the Latest Model Codes or Zero Energy Codes

To be used for applications submitted to Topic Area 2 and Topic Area 3

DOE has an established methodology for evaluating the energy savings from the latest model codes and amended versions of those codes.[6] Estimations of the energy savings potential of the Applicant's proposed code or LMC equivalent approach, and the efficiency components (before renewables) of the Applicant's proposed code or ZEC approach, must rely on the established DOE methodologies.

The calculation procedure to evaluate LMC or ZEC equivalency requires the determination of site energy savings from the proposed code and the site energy savings from the Applicant's current code, both compared against savings from adopting the statutory LMC or ZEC unamended. The procedure is comprised of the following steps:

1. Determine the site energy use from the code currently adopted in the applicable jurisdiction (**Section 4.1**)
2. Model and determine the site energy use from the proposed code and the corresponding LMC or ZEC (**Section 4.2**)
3. Apply values from (1) and (2) to projected new construction starts and code compliance rates over 30 years (**Sections 4.2.3**)
4. Determine the cumulative 30-year site energy savings for the proposed code and corresponding LMC or ZEC over the current code (**Section 4.3**)
5. Index results from (4) against the corresponding statutory LMC or ZEC (see Table 1) to determine equivalency (**Section 4.4**)

The following subsections outline this procedure. Applications for Topic Area 2, and aligned proposals being submitted to Topic Area 3, should follow the procedure identified in Subsections 4.1 through 4.6 below. The following terms are used to describe the code scenarios for comparison in the following sections:

- Current code energy performance (CCEP): the energy performance of the code that is currently effective in the jurisdiction
- Proposed code energy performance (PCEP): the energy performance of the code that the jurisdiction is proposing to adopt
- Qualified code energy performance (QCEP): the energy performance of the code that the jurisdiction is comparing their proposed code against to determine equivalence (reference Table 1, above for summary)

[6] Example applications of the methodology include:
Energy Savings Analysis: ANSI/ASHRAE/IES Standard 90.1-2019, Prototype Building Energy Models,
Energy Savings Analysis: 2021 IECC for Residential Buildings (PNNL),
Impacts of Model Building Energy Codes – Interim Update (PNNL)

4.1 Energy Use from Current Code

DOE conducts an evaluation of the energy performance of covered building types for the latest residential and commercial energy codes and those versions adopted by states for DOE's State Portal.[7] DOE provided input data on the energy use from the current code to support applicants in determining their current code energy performance (CCEP) for use in this methodology.

- *For States*: energy use of the current code must be taken from the data provided in Section 3. For States without a report, follow the guidance in Section 4.1.1, below.
- *For local governments*: energy use of the current code must be taken from the corresponding State data in Section 3 and scaled by population according to the 2020 Census.[8]

4.1.1 Applicants Without Provided Data[9]

States and local governments with the authority to adopt building codes that do not have input data provided in the sources listed in Section 3, must use the building prototypes corresponding to the Applicant's current version of the residential or commercial building energy code to calculate the CCEP. DOE provides building energy models for 16 commercial prototype buildings in 19 climate locations configured to the requirements of the latest and past versions of ASHRAE 90.1 and 32 residential prototype buildings in 18 climate locations configured to the latest and past versions of the IECC.[10] This set of building energy models can be used to calculate the energy use of buildings under the current code and then scaled to the level of the Applicant's jurisdiction using projections of construction starts (calculated using the methodology described in Section 4.2.1) for each building type within the state.

Alternate modeling approaches may be used if they meet the requirements outlined in Section 3.1 and technical documentation is provided in support of the equivalence calculation as part of the application. The calculations and results will undergo a technical review by DOE as part of the initial application merit review process.

For multi-jurisdictional applications: if a coalition of jurisdictions apply together, the included jurisdictions should follow the appropriate directions, above, and submit an equivalence calculation for each jurisdiction included in the application.

4.2 Calculating Energy Code Performance and Savings

4.2.1 Modeling the Proposed Code (LMC) and Efficiency Backstop (ZEC)

To calculate the proposed code energy performance (PCEP), the Applicant must take the corresponding building prototype models and calculate the energy performance of the code being proposed, including all relevant amendments and alterations, for each building type. For zero energy codes (Topic Area 2 Subtopics C and D), energy savings is calculated relative to the efficiency backstop (the minimum efficiency requirement before adding renewable

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[7] https://www.energycodes.gov/state-portal

[8] https://www.census.gov/data/tables/time-series/demo/popest/2020s-total-cities-and-towns.html

[9] Applicants using this methodology for Topic Areas 2 and 3 may be able to provide input data for DOE to conduct this analysis on their behalf during application eligibility reviews. Review Section IV(D)(vi) for more information on this option.

[10] https://www.energycodes.gov/prototype-building-models

generation – site energy use intensity (EUI) for commercial, RESNET/ICC 301-2019 Energy Rating Index (ERI) for residential).

Alternate modeling approaches may be used if they meet the requirements outlined in Section 3.1 and technical documentation is provided in support of the equivalence calculation as part of the application. The calculations and results will undergo a technical review by DOE as part of the initial application merit review process.

The energy performance of each building type is then scaled using new construction start data sources provided in Section 3.2 forecast over 30 years. For example, with a proposed commercial code:

$$PCEP = \sum_{30\ years}^{Building\ Types} Site\ EUI\ \times New\ Construction\ Starts$$

4.2.2 Modeling the Corresponding Qualified Code

To calculate equivalence, the qualified code energy performance (QCEP) must be provided. For most States, the QCEP is available through data provided in Section 3.[11] Local governments must use the applicant jurisdiction's population data from the 2020 Census to scale State-level QCEP figure for local use.

To calculate the QCEP where one is not provided by DOE, applicants must repeat the methodology outlined in Section 4.2.1 using the unaltered prototype models provided by DOE.[12]

4.2.3 Code Compliance Rates and Future Projections

In line with established DOE building energy code analysis methodologies, a realized savings rate must be incorporated into the calculation, along with assumptions related to the future code adoptions. The following factors must be applied to the results from the calculation in the previous Section 4.2.1 and 4.2.2 to determine the proposed code energy savings (PCES) and the qualified code energy savings (QCES).

- Proposals for commercial codes will use 50% for the first year the code is adopted, increasingly asymptotically every year until it reaches 80% in year 10.
- Proposals for residential codes will use 80% for the first year the code is adopted, increasingly asymptotically every year until it reaches 100% in year 10.[13]

4.3 Aggregated Site Energy Savings

The relevant aggregated site energy savings are then calculated using two equations:

A State will calculate:

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[11] https://www.energycodes.gov/ira-codes-equivalence-methodology-inputs

[12] https://www.energycodes.gov/prototype-building-models

[13] These assumptions are based on observations from the commercial and residential energy code field studies conducted by DOE (Tyler et al. 2023, Blanding et al. 2022, and Ecotope 2020), The DOE impact analysis methodology also includes assumptions related to future code adoption.

$$QCES = (Realization\ Rate \times QCEP) - CCEP$$

and

$$PCES = (Realization\ Rate \times PCEP) - CCEP$$

Units of local government will use population data from the 2020 Census to appropriately scale the aggregated site energy savings in their jurisdiction(s):[14]

$$QCES = \frac{Population_{Applicant}}{Population_{State}} \times [(Realization\ Rate \times QCEP) - CCEP]$$

and

$$PCES = \frac{Population_{Applicant}}{Population_{State}} \times [(Realization\ Rate \times PCEP) - CCEP]$$

These calculations result in the cumulative 30-year savings value for submission.

4.4 Equivalency

4.4.1 Equivalent or Greater Energy Savings for LMC

Cumulative 30-year site energy savings for the eligible jurisdiction from adopting and implementing the proposed code (PCES) shall be compared to the 30-year site energy savings estimated from adopting and implementing the comparable LMC (QCES). The aggregated site energy savings from the proposed code are indexed against the aggregated site energy savings from the comparable LMC. A resulting value greater than or equal to 1 demonstrates equivalence and, consistent with established DOE building energy code impact analyses, estimates within 1% of the comparable LMC will be considered equivalent. The following ratio will establish equivalent or greater energy savings of a proposed code with a qualified code:

$$\frac{PCES}{QCES} \geq 0.99$$

4.4.2 Equivalent Stretch Code for ZEC

Equivalency of the proposed code with the zero energy provisions of the 2021 IECC is evaluated on two levels, a minimum efficiency backstop and renewable energy requirements. To be considered equivalent, a proposed code must be no less stringent than both of these provisions.

For commercial building codes, evaluating equivalence to Appendix CC:

1. Minimum efficiency backstop: An efficiency level that results in equal or higher site energy savings than those accrued through the prescriptive and mandatory provisions of the commercial provisions of the 2021 IECC Appendix CC, prior to any consideration of on-site or offsite renewable energy procurement. The following equation is used for this calculation, allowing a 1% margin for error in line with established DOE building energy code analyses:

[14] https://www.census.gov/data/tables/time-series/demo/popest/2020s-total-cities-and-towns.html

$$\frac{PCES}{QCES} \geq 0.99$$

2. Renewable energy requirements: A combination of onsite renewable energy generation and offsite procurement appropriately discounted by procurement factors that is equal or greater than the site energy consumed by building compliant with the proposed code. Additionally, offsite renewables must be one of the qualifying offsite procurement methods listed in Section CC103.3.1 of the 2021 IECC and must meet the requirements set forth in section CC103.3.2.

Like the technical approach described for commercial buildings, equivalence for residential building codes evaluating equivalence to Appendix RC is evaluated on two levels:

1. Minimum efficiency backstop: An efficiency level that results in equal or higher site energy savings than those accrued through the ERIs required by Appendix RC prior to any consideration of on-site or offsite renewable energy procurement. The following equation is used for this calculation leveraging appropriate site energy intensities corresponding to required ERIs, allowing a 1% margin for error in line with established DOE building energy code analyses:

$$\frac{PCES}{QCES} \geq 0.99$$

2. Renewable energy requirements: A combined level of efficiency and renewable energy that results in equal or higher site energy savings than those accrued through an ERI equal to zero.

4.5 Documentation Requirements

At a minimum, the following results and assumptions must be submitted to DOE for a technical review of the calculation and equivalency results. Any additional data that might be relevant for providing a complete overview of the calculations should also be submitted as appropriate.

1. Name, State, and locality (if applicable) of Building Code Authority
2. Proposed code adoption year for residential and/or commercial buildings, as applicable
3. Identification of the proposed code and the corresponding list of amendments, alterations, and other relevant changes modeled as part of this equivalency evaluation
4. Details of building energy modeling or other methods used in estimating energy savings over baseline, including technical approaches and assumptions
5. 30-year cumulative site energy for baseline and proposed code and savings
6. *ZEC Only*: Details of renewable energy generation requirements and procurement factors

Section 5: Methodology for Determining Innovative Building Energy Code Approaches for Existing Buildings (e.g., BPS) Equivalence to the Latest Model Codes or Zero Energy Codes

*To be used for applications submitted to **Topic Area 3***

The innovative building energy code for existing buildings calculation procedure compares site energy use for existing buildings impacted by the innovative building energy code with a baseline scenario where no innovative building energy code for existing buildings is in place. The comparisons are conducted using the cumulative 30-year site energy savings scenario, calculated using the year that the policy is anticipated to go into effect and the length of the compliance period. The following subsections specify this calculation procedure, and a corresponding calculator has been published based on this methodology.[15] Applications for Topic Area 3, Subtopics A and B, that apply to existing buildings must either follow the procedure identified below or use the calculator to determine whether the proposed innovative building energy code achieves the required energy savings.

Note: Innovative building energy code approaches to existing buildings typically apply to commercial and large multifamily buildings. The methodology in the following sections should be used for proposals covering existing commercial and multifamily buildings. For proposals covering existing single family and small multifamily buildings, reference the explanation in Section 5.6.

5.1 Existing Building Stock

For Applicants proposing to adopt an innovative building energy code covering the existing building stock, the current energy use of the Applicant's existing building stock will serve as the calculation baseline for potential savings.

5.1.1 Building Stock Data

The primary data source for existing commercial and multifamily building stock used to perform the calculations for the building energy code for existing buildings equivalency are the National Renewable Energy Laboratory's ComStock Analysis Tool[16] and ResStock Analysis Tool.[17] The Building Energy Code for Existing Buildings Equivalency Calculator utilizes the ComStock and ResStock data set as the source for the existing building stock.

ComStock leverages the PNNL/DOE prototype commercial building energy models to estimate the performance of the existing commercial building stock. ResStock is used to estimate the performance of the existing multifamily building stock. ResStock models are based on individual dwelling units (not whole buildings). Therefore, the following methodology is implemented to estimate multifamily floor area subject to building energy codes for existing buildings:

- Only dwellings modeled in ResStock representative of those found in multifamily buildings greater than three stories (subject to commercial building energy codes) are considered.

[15] https://infrastructure-exchange.energy.gov/Default.aspx
[16] https://comstock.nrel.gov/
[17] https://resstock.nrel.gov/

- For any applicable multifamily dwelling, the floor area of the modeled dwelling unit from ResStock is multiplied by the number of dwelling units (also a ResStock input), and then:
    - an additional 14.6% floor area is added to account for common space of Mid-Rise Multifamily buildings matching the PNNL/DOE prototype Mid-Rise Multifamily building model, or
    - an additional 11.6% floor area is added to account for common space of High-Rise Multifamily buildings matching the PNNL/DOE prototype High-Rise Multifamily building model.

ComStock and ResStock data are aggregated at the state level by building type and by building size for the purpose of the equivalency calculation to match the state-level impacts for latest model codes and zero energy codes as previously described.

A state or jurisdiction may elect to utilize an actual existing building stock dataset (such as a covered buildings list collected through a benchmarking policy) if it is a complete accounting of buildings covered under the proposed building energy code for existing buildings and is not an aggregate of sources and/or statistical inferences. The state or jurisdiction must then perform their own equivalency calculation following the procedure outlined in this section in its entirety. All other data sets, including new construction, must match this methodology. Only an existing building stock data set of actual buildings may be substituted. If an Applicant elects to use their own building stock dataset, that data must be submitted along with the completed equivalence calculation as part of the funding application.

For custom calculations, the floor area expected to be impacted by the proposed building energy code for existing buildings is calculated by building type on an annual basis to develop 30-year projections. This information may be derived from building stock assessments or other inventory studies conducted on the existing building stock within the eligible jurisdiction. Floor space thresholds defined by the building energy code for existing buildings are applied in the calculation of the impacted floor area as appropriate. If custom or local data is unavailable, impacted floor area must be determined using National Renewable Energy Laboratory's ComStock Analysis Tool[18] and ResStock Analysis Tool.[19]

5.1.2 Building Types

ComStock models are based on the PNNL/DOE Commercial Building Prototypes Models[20] and therefore include the following:

- Full-service restaurant and quick service restaurant
- Small and large hotel
- Small, medium, and large office
- Outpatient medical buildings
- Inpatient hospitals
- Standalone and strip mall retail stores

[18] https://comstock.nrel.gov/
[19] https://resstock.nrel.gov/
[20] https://www.energycodes.gov/prototype-building-models

- Primary and Secondary schools
- Non-refrigerated warehouses

ResStock data is used to generate Mid-Rise and High-Rise Multifamily buildings as described in Section 5.1.1. Building types that are not specifically covered by these prototypical models are excluded from the ComStock dataset. The building types covered by ComStock and ResStock data match those found in the impact analyses for latest model codes and zero energy codes and are therefore in alignment for the equivalency calculation.[21]

5.1.3 Building Sizes

ComStock and ResStock data for commercial and multifamily buildings larger than 10,000 square feet are included in the equivalency calculation.[22] Those buildings are summarized into size ranges to allow users to consider characteristics of the building energy code for existing buildings that impact all, or only certain building sizes. Those size ranges are as follows:

- 10,001 – 20,000 square feet
- 20,001 – 50,000 square feet
- 50,001 – 100,000 square feet
- 100,001 – 200,000 square feet
- Above 200,000 square feet

5.1.4 Existing Building Energy Use

ComStock and ResStock data are used to generate representative existing building energy use based on building types and building sizes for each state. A floor area-weighted median site energy use intensity (EUI) is calculated for each building type and building size range for each state and is used to represent existing building performance for that type, size, and location.

If an applicant elected to use its own covered buildings list as input data per Section 5.1.1, they must incorporate actual site EUI values for the calculation in this step. The submitted input data along with the calculation must include the reported site EUI for each building record. Those site EUIs can then be processed by the applicant to represent the floor area-weighted median site EUI for each building type.

To determine the existing stock energy use (ESEU) applicant will calculate:

$$ESEU = \sum_{30\,Years}^{Building\,Types} Median\ Site\ EUI\ \times Covered\ Floor\ Area_{Year}$$

5.1.5 Demolition Rate

A building demolition rate based on local data shall be applied to the existing building stock on an annual basis to account for older buildings that will get demolished over the 30-year analysis timeframe. In absence of local data, an annual demolition rate of 1.2% shall be

[21] https://www.energycodes.gov/impact-analysis

[22] Further guidance for determining equivalence for innovative codes that include single family and small multifamily buildings under 10,000 square feet can be found in Section 5.6.

applied based on data from the Energy Information Administration (EIA) National Energy Modeling System (NEMS).[23]

5.2 New Construction Rollover

New construction and major renovation floor area (i.e.: subject to new construction code) is considered to become subject to the building energy code for existing buildings based on the following methodology and set of assumptions:

- New construction volume is estimated following the methodology and assumptions matching the latest model codes impacts analysis[24]
- New construction floor area is assumed to be subject to the building energy code for existing buildings once a building has been operational for 5 years
- A demolition rate is not applied to any new construction floor area subject to the building energy code for existing buildings over the 30-year calculation. This matches assumptions for the latest model codes impacts analysis[25]

New construction is assumed to become subject to requirements of the building energy code for existing buildings during the 30-year analysis timeframe and should leverage data provided in Section 3.2. New construction starts should be scaled according to the proportion of total floor area for each size bin in Section 5.1.3 that will be covered by the proposed BPS.

5.2.1 New Construction Energy Use

The new construction energy use (NCEU) is assumed to be at the level of the current building energy code requirements at the start of the calculation, consistent with the latest model codes impacts analysis. Over the duration of the 30-year calculation, each jurisdiction is assumed to adopt subsequent building energy codes at the same frequency as those assumptions made in the latest model codes impact analysis.[26] Only new construction site energy usage that is higher than the code's outcome-based targets is included in the energy savings calculation for the purpose of equivalency. For methodological requirements around calculating new construction energy use, follow the guidance provided for the use of DOE Prototype Models in Section 4.

Baseline new construction energy use and new construction energy use under the proposed building energy code for existing buildings (indicated by subscript ECEB) should be calculated as follows:

$$NCEU_{Baseline} = New\ Construction\ Floor\ Area \times New\ Construction\ EUI_{Code}$$

$$NCEU_{ECEB} = New\ Construction\ Floor\ Area \times New\ Construction\ EUI_{ECEB}$$

[23] https://www.eia.gov/outlooks/aeo/assumptions/pdf/commercial.pdf
[24] https://www.energycodes.gov/impact-analysis
[25] https://www.energycodes.gov/impact-analysis
[26] https://www.energycodes.gov/impact-analysis

5.3 Calculation of Overall Site Energy Savings

The site energy savings from a building energy code for existing buildings is calculated based on the energy savings anticipated from the implementation of the energy code for existing buildings compared to a scenario without an energy code for existing buildings in place. The energy use for a scenario without an energy code for existing buildings is determined based on current existing building energy use in the jurisdiction.

When existing building energy use data is unavailable for the jurisdiction, ComStock and ResStock may be used to generate representative median building EUIs based on building type and size. A percentage reduction on the baseline EUI may be used to calculate the savings potential from the energy code for existing buildings for each building type and size. Applicants will use a 30-year site EUI savings target of 45% unless an already drafted policy with an established long-term savings goal is submitted as part of the application, in which case the applicant should use the established long-term savings goal from that policy. Savings factors should be broken down annually in accordance with the applicant's proposed savings trajectory. These factors will be represented as Energy Use Intensity Savings Factor (EUISF). Once the median site EUI for a building type reaches the limit set by the 25th percentile in ASHRAE Standard 100,[27] stepped down by state over time,[28] further savings should not be applied to that building type. The step down added to the Standard 100 site EUIs is meant to estimate the efficiency gains from improvements in available technologies made over time that would apply to existing buildings for the purposes of this equivalence analysis.

A savings realization rate of 70% is used as a default to represent the proportion of the building stock that will achieve performance-based compliance with the energy code for existing buildings. The different building type EUIs should be weighted appropriately and multiplied by the impacted floor area to determine the eligible jurisdiction energy savings from the proposed code.

$$ECEB_{Baseline} = ESEU + NCEU_{Baseline}$$

and

$$ECEB_{Savings} = 0.7 \times (ECEB_{Baseline} - (\sum_{30\ Years}^{Building\ Types} EUISF_{Year} \times ESEU) - NCEU_{ECEB})$$

5.3.1 GHG emission-based targets for existing buildings

Some jurisdictions may pursue innovative building energy codes with GHG emissions metrics. In these cases, the emissions metric will be used as a proxy for evaluating site energy use and the overall energy savings of the proposed innovative building energy code. For eligible jurisdictions with an emissions-based approach, equivalency will be determined based on aggregated site energy savings expected from emission reductions using specified annual CO_2 factors for electricity, natural gas, and other fossil fuels assumed in the building stock (GHG Factors). Applicants must use annual emissions factors obtained according to the

[27] https://www.ashrae.org/technical-resources/bookstore/standard-100
[28] https://www.energycodes.gov/impact-analysis

source data provided in Section 3.2. Similar to the site EUI approach, GHG savings targets in the proposed code should be broken down into annual targets in accordance with the applicant's proposed savings trajectory. The GHG savings targets should be calculated as a percent improvement in emissions with grid contributions excluded to best represent building-level energy savings for the purposes of this equivalence calculation. These savings targets will be represented as Greenhouse Gas Savings Target (GHGST).

$$ECEB_{Baseline\ GHG} = (ESEU + NCEU_{Baseline}) \times GHG\ Factors_{Year}$$

GHG-based energy code for existing buildings savings, incorporating the 70% realization rate, will be calculated as follows:

$$ECEB_{Savings\ GHG} = 0.7 \times (\ ECEB_{Baseline\ GHG} - \left(\sum_{30\ Years}^{Building\ Types} GHGST_{Year} \times ECEB_{Baseline\ GHG\ Year} \right))$$

GHG-based savings will be converted to energy savings by considering annual electricity and gas consumption across the building stock with corresponding emissions factors, below:

$$ECEB_{Savings} = \sum_{30\ Years}^{Building\ Types} \frac{ECEB_{Savings\ GHG}}{(Electricity_{Year} \times GHG\ Factors_{Year}) + (Gas_{Year} \times GHG\ Factors_{Year})}$$

5.4 Equivalency Determination

Cumulative 30-year site energy savings anticipated from adopting and implementing the proposed innovative building energy code approach to existing buildings are compared to the 30-year site energy savings estimated from adopting and implementing the latest model codes or zero energy codes, as appropriate. The methodology for determining the applicable QCES (savings from adopting and implementing the latest model codes or zero energy codes) is described in Section 4 of this document.

$$\frac{ECEB_{Savings}}{QCES} \geq 0.99$$

When site energy savings from the energy code for existing buildings for the impacted floor area are equal or greater than those for the latest model codes or zero energy codes for new construction, additions, and alterations volume, the proposed code is deemed equivalent. Similar to previous sections, a 1% margin is allowed in line with established DOE building energy code analyses.

For a proposed building energy code for existing buildings to be deemed equivalent to a zero energy code, the above energy savings requirement must be met as well as the following renewable energy requirements:

- a combination of onsite renewable energy generation and offsite procurement appropriately discounted by procurement factors that is equal or greater than the site energy consumed by building compliant with the proposed code; and

- offsite renewables shall be one of the qualifying offsite procurement methods listed in Section CC103.3.1 of the 2021 IECC and will have to meet the requirements set forth in section CC103.3.2.

5.5 Documentation Requirements

The following results and assumptions must be submitted to DOE for a technical review of the calculation and equivalency results. Any additional data that might be relevant for providing a complete overview of the calculations should also be submitted as appropriate.

1. Name, State, and locality (if applicable)
2. Code adoption year and effective year
3. Code target year
4. Code target site energy savings reduction or GHG reduction
5. Building types impacted by Code
6. Building sizes included in Code
7. Impacted floor area in square feet, annually, by building type
8. 30-year cumulative site energy savings

5.6 Building Energy Codes for Existing Single Family and Small Multifamily

Innovative approaches to building energy codes for existing buildings have been nearly exclusively focused on commercial and large multifamily buildings, with size thresholds above 10,000 square feet. The methodology presented in Sections 5.1-5.4 focuses on those building types typically covered by commercial building codes. If an Applicant proposes a building energy code for existing buildings typically covered by a residential building code, an equivalence calculation must be conducted following the methodology in Section 5. The statute-specified code for comparison is the 2021 IECC for latest model code equivalence and 2021 IECC Appendix RC for zero energy code equivalence.

Definition of Terms

Building Performance Standard (BPS): An innovative building energy code (i.e., an innovative code that is measurable, verifiable, and enforceable) to reduce the energy consumption or carbon impact of existing buildings. Currently, most BPS address larger commercial and multifamily buildings and use site energy metrics, though some BPS are designed around greenhouse gas emission metrics.

Current Code: The building energy code that has been adopted in the applicant jurisdiction is defined as the baseline code within this document.

Eligible Jurisdiction: States and units of local government with the authority to adopt building codes.

Latest Model Code (LMC): In accordance with Section 50131 of the IRA, the latest model code for commercial buildings is ASHRAE 90.1-2019 and that for residential buildings is the 2021 International Energy Conservation Code.

Stretch Code: The building energy code that goes beyond the minimum state baseline code that is in effect in the eligible jurisdiction is called a stretch code or a reach code. Some states and local jurisdictions employ stretch codes as a mechanism for driving energy efficiency in new construction even further than the state code as an option for localities within the state.

Zero Energy Code (ZEC): In accordance with Section 50131 of the IRA, Appendix CC of the 2021 IECC is the zero-energy code for commercial buildings and Appendix RC of the 2021 IECC is the zero-energy code for residential buildings. Beyond energy efficiency provisions, Appendix RC and CC also contain requirements on-site and off-site renewable energy procurement.

Definition of Acronyms

BPS	Building Performance Standards
CCEP	Current Code Energy Performance
DOE	U.S. Department of Energy
ERI	Energy Rating Index
ESEU	Existing Stock Energy Use
EUI	Energy Use Intensity
EUISF	Energy Use Intensity Savings Factor
FOA	Funding Opportunity Announcement
GHG	Greenhouse Gas
GHGST	Greenhouse Gas Savings Targets
IECC	International Energy Conservation Code
IRA	Inflation Reduction Act
LMC	Latest Model Code
NCEU	New Construction Energy Use
NEMS	National Energy Modeling System
PCEP	Proposed Code Energy Performance
PCES	Proposed Code Energy Savings
PNNL	Pacific Northwest National Laboratory
QCEP	Qualified Code Energy Performance
QCES	Qualified Code Energy Savings
SCEP	DOE Office of State and Community Energy Programs
ZEC	Zero Energy Code

Exhibit A: GHG Emissions Factors for Equivalency Analysis

Note: Emission factors held constant for years past 2050.

Abbreviation	GHG
CO_2	Carbon Dioxide

Electricity (kg/MWh)

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
CO_2	437.2849	437.2474	437.2622	380.7203	324.9656	280.7549	250.9349	230.8727	220.3602	213.5551	207.6873	202.7795	198.7112

Electricity (kg/MWh)

Continued

	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CO_2	195.7158	191.282	188.1098	186.5531	184.8233	184.0098	183.4079	182.3121	179.026	176.1043	172.1126	169.5089	167.0064	165.1615	162.5548

Natural Gas (kg/MMBtu)

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
CO_2	59.91892	59.91892	59.91892	59.86294	59.79699	59.7337	59.73127	59.74996	59.77455	59.83278	59.85969	59.88147	59.8694

Natural Gas (kg/MMBtu)

Continued

	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CO_2	59.89421	59.88035	59.86924	59.86718	59.85685	59.8564	59.87568	59.89376	59.94101	59.93223	60.00183	59.97943	60.04446	60.05849	60.00756