

June 18, 2024

**VIA ELECTRONIC FILING**

Rosemary Chiavetta, Secretary  
Pennsylvania Public Utilities Commission  
Commonwealth Keystone Building  
400 North Street, 2<sup>nd</sup> Floor North  
P.O. Box 3265  
Harrisburg, PA 17105-3265

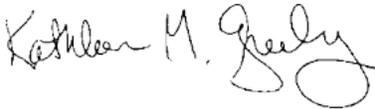
**Re: Implementation of the Alternative ENERGY Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2026 Update – Docket No. M-2023-3044491**

Dear Secretary Chiavetta:

Pursuant to the Commission's May 9, 2024 Tentative Order in the above referenced proceeding, please see Performance Systems Development's comments enclosed for consideration.

Respectfully submitted,

Kathy Greely, CEO



Performance Systems Development of New York, LLC  
40 W. Evergreen Avenue, Ste. 110  
Philadelphia, PA 19119  
(814) 558-8082  
[kgreely@psdconsulting.com](mailto:kgreely@psdconsulting.com)

KG/ad  
Enclosures

cc: Regi Sam (via e-mail – [rsam@pa.gov](mailto:rsam@pa.gov)) Tiffany Tran (via e-mail – [tiftran@pa.gov](mailto:tiftran@pa.gov)) Adam Young (via e-mail – [adyoung@pa.gov](mailto:adyoung@pa.gov))

**BEFORE THE  
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

Implementation of the Alternative Energy :  
Portfolio Standards Act of 2004: Standards :  
For the Participation of Demand Side : Docket No. M-2023-3044491  
Management Resources – Technical :  
Reference Manual 2026 Update :

**COMMENTS OF  
PERFORMANCE SYSTEMS DEVELOPMENT**

By Tentative Order entered May 9, 2024, the Pennsylvania Public Utility Commission (“Commission”) requested comment on the proposed 2026 update of the Commission’s Technical Reference Manual (“TRM”) which will apply to Phase V of the Act 129 Energy Efficiency and Conservation (“EE&C”) Programs for electric distribution companies (“EDCs”). Pursuant to the Tentative Order, Performance Systems Development (“PSD”) submits the following comments regarding updates to the 2026 TRM.

**Background**

PSD has continuously operated as a Conservation Service Provider (“CSP”) of ACT 129 EE&C programs since 2010 and currently serves as the CSP for the Residential New Construction (“RNC”) portion of FirstEnergy, PPL, and PECO’s Residential EE&C portfolios. PSD additionally implements RNC programs for UGI and PGW, as well as other major utilities across the country. PSD appreciates the significant positive changes proposed for the Residential New Construction measure in the 2026 TRM. As detailed below, PSD has identified several areas of the Proposed TRM that it believes could benefit from modification, clarification, or improved alignment with industry standards and best practices. Additionally, PSD strongly suggests the

adoption of a market baseline to properly attribute savings to new construction programs and provides example research, implementation, and best practices from other markets to support said adoption. A redlined version of the Proposed TRM is included here as Appendix A to demonstrate possible implementation of the suggested changes.

## **Comments on the Proposed 2026 TRM**

### **ENERGY STAR Framework**

In alignment with previous iterations of the PA TRM, the proposed 2026 TRM makes use of significant citations from ENERGY STAR's Single-Family New Homes and Multifamily New Construction programs to guide the RNC measure (see Source 1 and Source 6 of the proposed measure). In Phase IV, the adopted measure was out of date at the time of adoption and was not updated to align with these programs as they changed. This misalignment led to market confusion and resulted in significant efforts among EDCs, evaluators, and implementation teams to reach alignment of the TRM with industry practice (including the development of an Interim Measure Protocol that guided the current proposed measure). Should the Commission and Statewide Evaluator find ENERGY STAR frameworks valuable in the development of the RNC measure, PSD suggests that the Commission and Statewide Evaluator commit to an ongoing review and update of these citations via the Codes and Standards Update process to ensure ongoing alignment between the measure and ENERGY STAR guidance.

### **ENERGY STAR Software**

The proposed measure cites ENERGY STAR Multifamily New Construction simulation guidelines to define qualifying software for ASHRAE modeled multifamily buildings. PSD suggests that the

measure similarly cite ENERGY STAR Certification System Guidelines for other pathways.<sup>1</sup> This list of approved software is inclusive of, but broader than, RESNET Accredited software. Citing EPA guidance will best align the measure with industry practice as it evolves. As the measure already includes non-RESNET accredited software for other pathways (including Passive House Planning and WUFI software) adding additional EPA approved software types aligns with the spirit of the proposed measure. PSD has provided suggested language in the example redlined measure included here as Appendix A.

### **New Construction Savings Baselines**

Current Act 129 baseline conventions and evaluation methodologies significantly underestimate the savings attributable to above-code new construction programs. Since its inception, the Act 129 TRM has assumed a code baseline in new construction contexts. A large body of industry research and ongoing practice within energy efficiency programs shows that code compliance significantly lags code adoption. This means that Act 129 currently employs a baseline that is well ahead of building practice and subsequently attributes fewer savings than it should to above-code new construction programs. The planned adoption of the 2021 IECC in the next phase of Act 129 threatens to exacerbate this issue. As discussed later, a recent code compliance study in New Jersey suggests that Act 129 (assuming similar market conditions) may be undercounting electric and gas savings in residential new construction programs by over 40%. Without the full attribution of above market performance, programs struggle to justify incentives that meet true market conditions and associated incremental costs. Right sizing baselines to market conditions will allow programs to claim their actual impact and additionally justify incentives that meet real market

---

1

<https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Certification%20System%20022-05-09.pdf>

needs. Above code RNC programs operate in those real markets even when baselines do not properly reflect the conditions of the market.

Additionally, longstanding research from similar markets shows significant non-participant spillover for new construction programs. New construction programs continually and effectively support the training of trades and subcontractors, create awareness of energy efficiency best practices, and raise the competitive bar for builders in ways that markedly increase the efficiency of homes that do not participate in energy efficiency programs. Not accounting for these market effects underestimates the impact and cost effectiveness of new construction programs. Recent market effects research in Wisconsin found impacts that would result in 19,496 MWh and 124,068 MMBtu of attributable benefit if applied in Pennsylvania.<sup>2</sup>

While establishing a market baseline would create additional up front EM&V costs, market baseline studies are generally cost effective – ranging from \$200k to \$400k in one time cost – relative to the significant savings they make attributable and would bring significant benefit to Act 129 programs and ratepayers.

### **Residential Energy Code in PA**

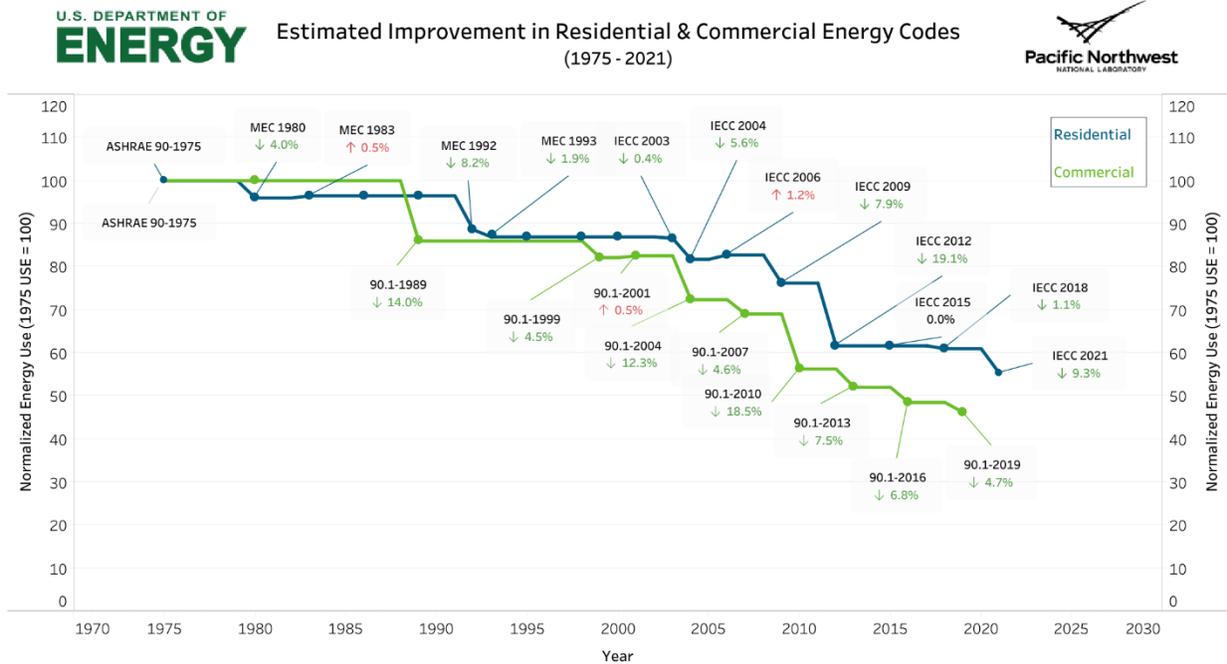
After years of minimal code advancement, Pennsylvania has rapidly increased energy code requirements, adopting the 2015 IECC effective October 1, 2018, and subsequently adopting the 2018 IECC effective February 14, 2022. As the chart below from the Pacific Northwest National Laboratory shows, the jump from the 2009 to 2018 IECC is the most significant historical

---

2

<https://assets.focusonenergy.com/production/WI%20Focus%20on%20Energy%20CY%202019%20Volume%20II.pdf>

improvement in efficiency in the IECC and consequently the most challenging for builders to acclimate to.



Additionally, Pennsylvania adopted the 2015 IECC with significant amendments, meaning the real brunt of increased stringency – especially infiltration requirements - are only now being realized in the market. Changes in energy code also represent a cost and education barrier for municipalities. Enforcement of many provisions of energy code – including envelope testing – has significantly lagged the adoption of code. The combination of these hurdles strongly suggests that the average new home built in Pennsylvania significantly underperforms current code requirements.

There is strong evidence from other markets to suggest that typical homes in Pennsylvania significantly underperform energy code. A 2018 mini-baseline study from the Mass Save program in Massachusetts showed that only 32% of non-program participating new homes were compliant

with code infiltration requirements of 3 ACH50 – the current residential code requirement in PA – more than three years after the adoption of that requirement.<sup>3</sup>

Table 16 shows compliance with mandatory air infiltration requirements. As shown, only 32% of late 2012 IECC homes meet the 2012 IECC air infiltration requirements. This is slightly lower than the early 2012 IECC sample compliance of 35%, though the differences are not statistically significant.

**Table 16: Compliance with Mandatory Air Infiltration (ACH50) Requirements**

	Custom	Spec	Late 2012 IECC	Early 2012 IECC <sup>1</sup>
<i>n (homes)</i>	21	29	50	98
Complies	38%	28%	32%	35%
Fails	62%	72%	68%	65%

No statistically significant differences at the 90% confidence level.

<sup>1</sup> The previous study reported compliance with ACH50 values rounded to the nearest whole number and thus reported a compliance rate of 58%. When rounded to the tenth digit, compliance in the early 2012 IECC sample is 35%.

It is important to note that Massachusetts has long running energy code training programs, as well as stretch codes, both of which support non-program code compliance. Neither stretch codes, or code compliance programs are present in Pennsylvania. It appears safe to assume that fewer homes in Pennsylvania are energy code compliant than were compliant in the Massachusetts study.

### **Attributable savings: Above Market Performance**

A failure to account for the under-code performance of typical homes in new construction markets results in significantly reduced attribution of savings for above-code new construction programs. If non-program participating homes perform significantly under code, programs should rightfully claim savings for the full over-market efficiency of participating homes. Those energy savings are no less real or less attributable to program participation than program homes’ “above-code” efficiency alone. Energy efficiency programs in other markets have recognized this problem and

<sup>3</sup> [RLPNC-17-2-Single-Family-New-Construction-Mini-Baseline-Study.pdf](#)

address this issue by establishing market baselines that capture the real performance of the new construction market.

The additional savings made attributable by this process are significant. A recent code compliance study from New Jersey<sup>4</sup> suggests that typical single-family detached homes in the state consume 15% more energy than they would if built to code. This represents total energy consumption of approximately 12.6 MMBtu per year – or by our estimate 1,003 kWh and 9.6 MMBtu per year, per home. Homes participating in Act 129 Residential New Construction programs in the last year claimed average savings of 2,556 kWh and 22.38 MMBtu. If code underperformance in New Jersey is at all similar to that in Pennsylvania, current Act 129 baselines may be under attributing both electric and gas savings by 40%, or 6,890 MWh a year. The New Jersey study did not address kW savings but the measures addressed in the compliance study surely have impact on demand. It should also be noted that the New Jersey compliance study shows significantly higher compliance rates than similar studies in Massachusetts, Connecticut, and elsewhere.

### **Attributable savings: Non-participant Spillover**

It is also well established that above-code new construction programs have real positive impact on the efficiency of non-participant homes. These market effects are well documented in new construction programs in Massachusetts, Connecticut, and Wisconsin and can be very significant. (See results from MA & CT and WI respectively.)<sup>5,6</sup> The presence of new homes programs in the market reduces the costs of efficient equipment, supports best practices of subcontractors who work on both program and non-program participating homes, and creates increased competition

---

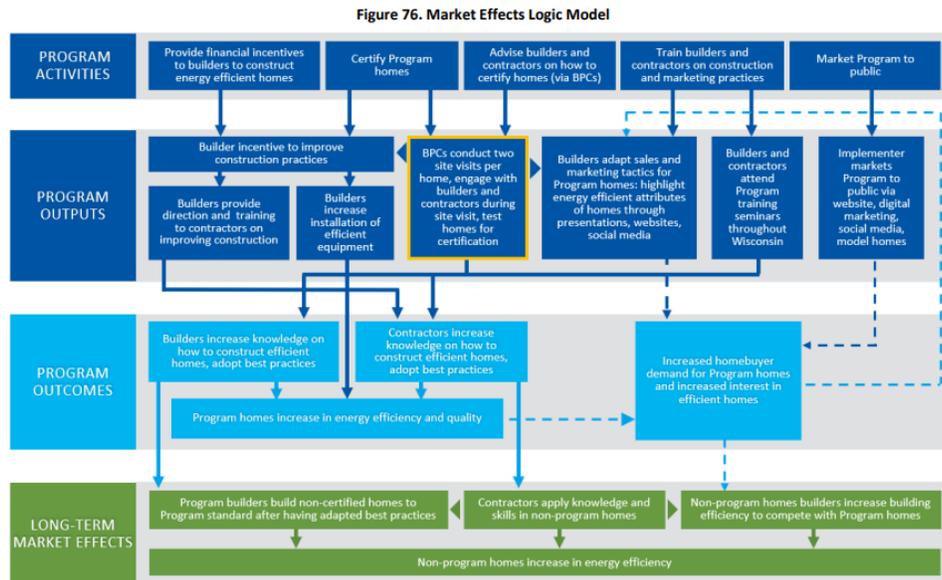
<sup>4</sup> [Rutgers New Jersey Energy Code Compliance Report\\_Final\\_clean.pdf \(njcleanenergy.com\)](#)

<sup>5</sup> [Pushing the Market: Measuring Market Effects in Residential New Construction \(nmrgroupinc.com\)](#)

<sup>6</sup> [Potential Study-Market\\_Effects-Residental\\_New\\_Construction.pdf \(s3.us-east-1.amazonaws.com\)](#)

between builders that pushes efficiency forward. See the logic model for market effects savings for the Focus on Energy New Construction program in Wisconsin below. <sup>7</sup>

CADMUS



The impact of market effects varies from market to market but if the market effects of the Focus on Energy program were applied to Pennsylvania, they would represent 19,496 MWh and 124,068 MMBtu of unclaimed benefit annually. See the results of the Focus on Energy Market Effects Study below.

**Table 63. Per-Home First-Year Market Effects Savings**

Electric/Natural Gas	Standard Non-Program Home Consumption	Counterfactual Non-Program Home Consumption	Market Effects Savings
kWh	8,996	9,766	770
kW	2.56	2.72	0.15
Therms	771	820	49

<sup>7</sup>

<https://assets.focusonenergy.com/production/WI%20Focus%20on%20Energy%20CY%202019%20Volume%20II.pdf>

Studies in Wisconsin, Massachusetts, Connecticut, and elsewhere suggest that current evaluation practice in Pennsylvania significantly underestimates the market impact and cost effectiveness of new construction programs. Underestimating this impact impairs the implementation of these programs and disincentivizes investment in one of the longest lived and deepest impact measures available in Act 129 portfolios.

## **Conclusion**

PSD is appreciative of the opportunity to provide comment on the Commission's Proposed 2026 TRM. Ensuring that measures reliant on EPA and ENERGY STAR guidance maintain alignment with that guidance will bring significant clarity to the market and lower implementation and EM&V burdens. Additionally, establishing market baselines for new construction programs via market characterization studies will allow those programs to claim their real benefit and incentivize investments in deep, longstanding, and impactful improvements. PSD views its recommendations as supportive of the intent of the Commission's Tentative Order and hopes its comments can assist in development of the Proposed 2026 TRM.

**BEFORE THE  
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

Implementation of the Alternative Energy :  
Portfolio Standards Act of 2004: Standards :  
For the Participation of Demand Side : Docket No. M-2023-3044491  
Management Resources – Technical :  
Reference Manual 2026 Update :

**COMMENTS OF PERFORMANCE SYSTEMS DEVELOPMENT**

**APPENDIX A**

## 2.7 Whole Home

### 2.7.1 Residential New Construction

<b>Target Sector</b>	Residential
<b>Measure Unit</b>	Multiple
<b>Measure Life</b>	Varies
<b>Vintage</b>	New Construction

#### ELIGIBILITY

---

This protocol documents the energy savings attributed to improvements to the construction of residential buildings compared to the baseline of a minimally code-compliant building, as calculated by the appropriate energy modeling software. This measure may be applied to attached or detached single-family homes and to multifamily residential buildings.

Mixed-use buildings are also eligible where the dwelling units and residential use common space combined exceed 50% of the building's square footage. Parking garage square footage is excluded from this calculation.<sup>Source 1</sup>

Multifamily buildings of 4 stories and higher are subject to the commercial building code and hence have different baseline specifications than buildings subject to residential building code requirements. Savings for multifamily buildings may be claimed only for savings generated in the residential spaces of the building.

#### ALGORITHMS

---

Energy and peak demand savings for Residential New Construction measures will be calculated by comparing outputs of energy models of the as-designed unit or building to a minimally code-compliant baseline unit or building. The characteristics of the baseline unit or building thermal envelope and/or system characteristics shall be based on the [most current statewide market baseline study, current state-adopted 2021 International Energy Conservation Code \(IECC\)](#).<sup>Source 2</sup>

[Savings should be modeled in alignment with ENERGY STAR guidance for applicable software:](#)

- [Savings modeled at the dwelling unit level should utilize RESNET accredited software or software that utilizes NREL's ERI ruleset for EnergyPlus](#).<sup>Source 2</sup>
- [Savings modeled at the building level should utilize modeling tools as designated by the ENERGY STAR Multifamily New Construction Program \(DOE-2, eQUEST, TRACE, HAP and EnergyGauge\)](#).<sup>Source 3</sup>

Alternately, savings may be produced with Passive House accredited software packages (Passive House Planning Package<sup>Source 4</sup> and WUFI Passive<sup>Source 5</sup>). Note, however, that the Passive House tools require the user to separately model the minimally code compliant reference design to calculate energy and demand savings.

~~For single-family homes and individual dwelling units, modeled energy savings shall be produced with a RESNET accredited software<sup>Source 3</sup> or the Passive House accredited software packages (Passive House Planning Package<sup>Source 4</sup> and WUFI Passive<sup>Source 5</sup>), though both Passive House tools require the user to separately model the code baseline reference design to calculate energy and demand savings.~~

~~For multifamily buildings, modeled energy savings shall be produced at the building level with whole building modeling tools as designated by the ENERGY STAR Multifamily New Construction Program (eQUEST, DOE2.1, Energy Plus, Carrier HAP, Open Studio, and Trane Trace 700).<sup>Source 6</sup> Alternatively, RESNET accredited software<sup>Source 3</sup> or the Passive House accreditation software packages (Passive House Planning Package<sup>Source 4</sup> and WUFI Passive<sup>Source 5</sup>), may be used to model energy savings for each residential dwelling unit archetype, where dwelling archetype can be defined by one or more key metrics such as bedroom/bathroom counts or square footage ranges.~~

Energy savings will be calculated from the software output using the following algorithm:

*Energy savings of the qualified unit/building (kWh/yr)*

$$\Delta kWh = kWh_{base} - kWh_{ee}$$

If the modeling software provides building-level outputs of hourly energy consumption (an 8760 load profile), then coincident peak demand savings may be calculated by averaging the hourly energy savings during the TRM defined peak demand time period. The TRM peak demand time period is defined in Volume 1.

If the modeling software does not provide building-level outputs of hourly energy consumption, the system peak electric demand savings for shall be calculated from the software's calculated annual energy savings and the following algorithm:

*Coincident system peak electric demand savings (kW)*

$$\Delta kW_{peak,summer} = \Delta kWh \times ETDF_{summer}$$

$$\Delta kW_{peak,winter} = \Delta kWh \times ETDF_{winter}$$

## **DEFINITION OF TERMS (AMEND TABLE PER MARKET BASELINE STUDY)**

A summary of the input values and their data sources follows:

**Table 0-1: Terms, Values, and References for Residential New Construction**

Term	Unit	Value	Sources
$kWh_{base}$ , Annual energy consumption of the baseline home/unit/building.	$kWh$	Software Calculated	7
$kWh_{ee}$ , Annual energy consumption of the qualifying home/unit/building.	$kWh$	Software Calculated	8
$ETDF_s$ , Summer energy to demand factor	$kW/kWh$	0.0001376	9
$ETDF_w$ , Winter energy to demand factor	$kW/kWh$	0.0001967	9
$V_r$ , Rated storage volume of baseline water heater	<i>gallons</i>	EDC Data Gathering	EDC Data Gathering
Model inputs for baseline home	<i>Varies</i>	Less than 4 stories: See Table 0-2 and Table 0-3 4 stories and higher: See Table 0-5 and Table 0-6	

The following table lists the building envelope characteristics of the baseline reference home based on 2021 IECC for the two climate zones in Pennsylvania.

**Table 0-2: Baseline Insulation and Fenestration Requirements by Component for Buildings Less Than 4 Stories (Equivalent U-Factors)<sup>Source 10</sup>**

IECC Climate Zone	Fenestration U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor	Floor U-Factor	Basement Wall U-Factor	Slab R-Value & Depth	Crawl Space Wall U-Factor
4	0.30	0.55	0.40	0.024	0.045	0.098	0.047	0.059	10ci, 4 ft	0.065
5	0.30	0.55	0.40	0.024	0.045	0.082	0.033	0.050	10ci, 4 ft	0.055

**Table 0-3: Residential New Construction Baseline Building Values for Buildings Less Than 4 Stories**

Data Point	Value	Source
Air Infiltration Rate	3.0 ACH <sub>50</sub> for the whole house	11
Duct Leakage	4 CFM <sub>25</sub> (4 cubic feet per minute per 100 square feet of conditioned space when tested at 25 pascals)	11
Duct Insulation	Within ceiling insulation: R-8 Other locations not completely inside thermal envelope: R-8 where ≥3" in diameter and R-6 where <3" in diameter	11

Data Point	Value	Source
Mechanical Ventilation	HRV/ERV/Air handler = 1.2 CFM/Watt In-line supply or exhaust = 3.8 CFM/Watt Other (< 90 CFM) = 2.8 CFM/Watt Other (≥ 90 CFM) = 3.5 CFM/Watt	12
Lighting	Use baseline wattage as defined in the <b>Error! Reference source not found.</b> section of the TRM ( <b>Error! Reference source not found.</b> ), <b>Error! Reference source not found.</b> for the residential units, and Lighting Improvement section (3.1.1) and New Construction Lighting section (3.1.2) of the TRM for common spaces	
Appliances	Use baseline values as defined in applicable TRM measure for each appliance.	
Thermostat Type	Programmable, with ability to maintain zone temperature down to 55 °F (13 °C) or up to 85 °F (29 °C)	11
Temperature Set Points	Heating: 70°F Cooling: 78°F	11
<b>Heating Efficiency</b>		
Furnace	80% AFUE	13
Gas Fired Steam Boiler	82% AFUE	13
Gas Fired Hot Water Boiler	84% AFUE	13
Oil Fired Steam Boiler	85% AFUE	13
Oil Fired Hot Water Boiler	86% AFUE	13
ASHP, GSHP, PTHP	For residential units, see New Construction values in <b>Error! Reference source not found.</b> in Sec. <b>Error! Reference source not found.</b> For ductless heat pumps, use value for ASHP. For common areas, see New Construction values in Table 3-24 in Sec. 3.2.1. For ductless heat pumps, use value for ASHP.	
<b>Cooling Efficiency</b>		
All types	For residential units, see New Construction values in <b>Error! Reference source not found.</b> in Sec. <b>Error! Reference source not found.</b> For ductless heat pumps, use value for ASHP. For common areas, see New Construction values in Table 3-24 in Sec. 3.2.1. For ductless heat pumps, use value for ASHP. For Chillers, see values in Table 3-29 in Sec. 3.2.3.	
<b>Domestic WH Efficiency</b>		
Electric	See volume and load dependent values in in <b>Error! Reference source not found.</b> in Sec. <b>Error! Reference source not found.</b>	
Natural Gas	See volume and load dependent values in Table 0-4	13
Additional Water Heater Tank Insulation	None	

**Table 0-4: Minimum Residential Baseline Gas-Fired Uniform Energy Factors Based on Storage Volume and Draw Pattern**

<b><math>V_r</math>: Rated Storage Volume (gallons)</b>	<b>Draw Pattern</b>	<b>Max. Daily Hot Water Draw (gallons)</b>	<b>First Hour Rating (FHR) (gallons)</b>	<b>UEF Calculation</b>
≥20 gal and ≤55 gal	Very Small	10	$0 \leq \text{FHR} < 18$	$0.3456 - (0.0020 \times V_r)$
	Low	38	$18 \leq \text{FHR} < 51$	$0.5982 - (0.0019 \times V_r)$
	Medium	55	$51 \leq \text{FHR} < 75$	$0.6483 - (0.0017 \times V_r)$
	High	84	$\text{FHR} \geq 75$	$0.6920 - (0.0013 \times V_r)$
>55 gal and ≤120 gal	Very Small	10	$0 \leq \text{FHR} < 18$	$0.6470 - (0.0006 \times V_r)$
	Low	38	$18 \leq \text{FHR} < 51$	$0.7689 - (0.0005 \times V_r)$
	Medium	55	$51 \leq \text{FHR} < 75$	$0.7897 - (0.0004 \times V_r)$
	High	84	$\text{FHR} \geq 75$	$0.8072 - (0.0003 \times V_r)$
Instantaneous ≤2 gal and >50 kBtu/h	Very Small	10	$0 \leq \text{FHR} < 18$	0.80
	Low	38	$18 \leq \text{FHR} < 51$	0.81
	Medium	55	$51 \leq \text{FHR} < 75$	0.81
	High	84	$\text{FHR} \geq 75$	0.81

**Table 0-5: Baseline Insulation and Fenestration Requirements by Component for Buildings 4 Stories or Higher (Equivalent U-Factors)<sup>Source 14</sup>**

<b>Building Element</b>	<b>IECC Climate Zone</b>	
	<b>4</b>	<b>5</b>
Fixed Fenestration U-Factor	0.36	0.36
Operable Fenestration U-Factor	0.45	0.45
Skylight U-Factor	0.50	0.50
Roof U-Factor, Insulation entirely above roof deck	0.032	0.032
Roof U-Factor, Metal building	0.035	0.035
Roof U-Factor, Attic and other	0.021	0.021
Above Grade Wall U-Factor, Mass	0.104	0.090
Above Grade Wall U-Factor, Metal building	0.052	0.050
Above Grade Wall U-Factor, Metal framed	0.064	0.055
Above Grade Wall U-Factor, Wood framed and other	0.064	0.051
Below Grade Wall C-Factor	0.119	0.119
Floor U-Factor, Mass	0.057	0.057

Building Element	IECC Climate Zone	
	4	5
Floor U-Factor, Joist/framing	0.033	0.033
Slab-on-grade Floors, F-Factor, Unheated	0.52	0.52
Slab-on-grade Floors, F-Factor, Heated	0.62	0.62

**Table 0-6: Residential New Construction Baseline Building Values for Buildings 4 Stories or Higher**

Data Point	Value	Source
Air Infiltration Rate	0.3 cfm/ft <sup>2</sup>	15
Duct Insulation	Unconditioned spaces = R-6 Outside building = R-8 (zone 4) R-12 (zone 5)	16
Mechanical Ventilation	0.35 ACH but not less than 15 cfm/person	17
Lighting	Use baseline wattage as defined in the <b>Error! Reference source not found.</b> section of the TRM ( <b>Error! Reference source not found.</b> ), <b>Error! Reference source not found.</b> for the residential units, and Lighting Improvement section (3.1.1) and New Construction Lighting section (3.1.2) of the TRM for common spaces	
Appliances	Use baseline values as defined in applicable TRM measure for each appliance.	
Thermostat Setback	Maintain zone temperature down to 55 °F (13 °C) or up to 85 °F (29 °C)	11
Temperature Set Points	Heating: 70°F Cooling: 78°F	11
<b>Heating Efficiency</b>		
Warm air furnace, gas fired	81% E <sub>t</sub>	18
Warm air furnace, oil fired	82% E <sub>t</sub>	18
Boiler, hot water, gas fired	82% AFUE (< 300,000 Btu/h) 80% E <sub>t</sub> (≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h) 82% E <sub>c</sub> (>2,500,000 Btu/h)	18
Boiler, hot water, oil fired	84% AFUE (< 300,000 Btu/h) 82% E <sub>t</sub> (≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h) 84% E <sub>c</sub> (>2,500,000 Btu/h)	18
Boiler, steam, gas fired	80% AFUE (< 300,000 Btu/h) 79% E <sub>t</sub> (≥ 300,000 Btu/h)	18
Boiler, steam, oil fired	82% AFUE (< 300,000 Btu/h) 81% E <sub>t</sub> (≥ 300,000 Btu/h)	18

Data Point	Value	Source
ASHP, GSHP, PTHP	For residential units, see New Construction values in <b>Error! Reference source not found.</b> in Sec. <b>Error! Reference source not found.</b> For ductless heat pumps, use value for ASHP. For common areas, see New Construction values in Table 3-24 in Sec. 3.2.1. For ductless heat pumps, use value for ASHP.	
<b>Cooling Efficiency</b>		
All types	For residential units, see New Construction values in <b>Error! Reference source not found.</b> in Sec. <b>Error! Reference source not found.</b> For ductless heat pumps, use value for ASHP. For common areas, see New Construction values in Table 3-24 in Sec. 3.2.1. For ductless heat pumps, use value for ASHP. For Chillers, see values in Table 3-29 in Sec. 3.2.3.	
<b>Domestic WH Efficiency</b>		
Electric	See volume and load dependent values in <b>Error! Reference source not found.</b> in Sec. <b>Error! Reference source not found.</b>	
Natural Gas	See volume and load dependent values in Table 0-4	19
Additional Water Heater Tank Insulation	None	

$E_t$  = Thermal Efficiency;  $E_c$  = Combustion Efficiency

**Table 0-7: Minimum Commercial Baseline Gas- and Oil-Fired Uniform Energy Factors Based Fuel Type and Draw Pattern**

Equipment (specifications)	Draw Pattern	Max. Daily Hot Water Draw (gallons)	First Hour Rating (FHR) (gallons)	UEF Calculation*	
				Equipment Manufactured Before October 6, 2026	Equipment Manufactured After October 6, 2026
Gas-fired storage (>75 kBtu/h and ≤105 kBtu/h and ≤ 120 gal)	Very Small	10	$0 \leq \text{FHR} < 18$	$0.2674 - (0.0009 \times V_r)$	$0.5374 - (0.0009 \times V_r)$
	Low	38	$18 \leq \text{FHR} < 51$	$0.5362 - (0.0012 \times V_r)$	$0.8062 - (0.0012 \times V_r)$
	Medium	55	$51 \leq \text{FHR} < 75$	$0.6002 - (0.0011 \times V_r)$	$0.8702 - (0.0011 \times V_r)$
	High	84	$\text{FHR} \geq 75$	$0.6597 - (0.0009 \times V_r)$	$0.9297 - (0.0009 \times V_r)$
Oil-fired storage (>105 kBtu/h and ≤140 kBtu/h and ≤ 120 gal)	Very Small	10	$0 \leq \text{FHR} < 18$	$0.2932 - (0.0015 \times V_r)$	$0.2932 - (0.0015 \times V_r)$
	Low	38	$18 \leq \text{FHR} < 51$	$0.5596 - (0.0018 \times V_r)$	$0.5596 - (0.0018 \times V_r)$
	Medium	55	$51 \leq \text{FHR} < 75$	$0.6194 - (0.0016 \times V_r)$	$0.6194 - (0.0016 \times V_r)$
	High	84	$\text{FHR} \geq 75$	$0.6470 - (0.0013 \times V_r)$	$0.6470 - (0.0013 \times V_r)$
Electric instantaneous (>12 kW and ≤ 58.6 kW and ≤ 2 gal)	Very Small	10	$0 \leq \text{FHR} < 18$	0.80	0.80
	Low	38	$18 \leq \text{FHR} < 51$	0.80	0.80
	Medium	55	$51 \leq \text{FHR} < 75$	0.80	0.80
	High	84	$\text{FHR} \geq 75$	0.80	0.80

\*  $V_r$  is the rated storage volume (in gallons)

## EVALUATION PROTOCOLS

For most projects, the appropriate evaluation protocol is to verify installation and proper selection of default values.

## SOURCES

---

- 1) ENERGY STAR Multifamily New Construction Program Decision Tree. (2021, May). [Weblink](#)
- 2) [See ENERGY STAR Certification System for Homes and Apartments Using and Energy Rating Index or Dwelling Unit Modeling Compliance Path Weblink](#) (<https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Certification%20System%202022-05-09.pdf>) International Code Council. (2021). 2021 International Energy Conservation Code, Effective Use of the International Energy Conservation Code, Introduction. [Weblink](#)
- 3) [See the ENERGY STAR Multifamily New Construction Simulation Guidelines for guidance on qualifying software Weblink](#) ([https://www.energystar.gov/sites/default/files/asset/document/ENERGY\\_STAR\\_MFNC\\_Simulation\\_Guidelines\\_Version\\_1\\_Rev02\\_v2.pdf](https://www.energystar.gov/sites/default/files/asset/document/ENERGY_STAR_MFNC_Simulation_Guidelines_Version_1_Rev02_v2.pdf)) [See the RESNET National Registry of Accredited Rating Software Programs for a complete listing: Weblink](#)
- 4) Passive House Planning Package. [Weblink](#)
- 5) WUFI Passive. [Weblink](#)
- ~~6) See the ENERGY STAR Multifamily New Construction Simulation Guidelines for guidance on qualifying software: [Weblink](#)~~
- ~~7) Calculation of annual energy consumption of a baseline home from the home energy rating tool based on the reference home energy characteristics.~~
- ~~8) Calculation of annual energy consumption of an energy efficient home from the home energy rating tool based on the qualifying home energy characteristics.~~
- ~~9) Wilson et al. 2021. End-Use Load Profiles for the U.S. Building Stock: Methodology and Results of Model Calibration, Validation, and Uncertainty Quantification. NREL/TP-5500-80889. [Weblink](#)~~
- ~~10) 2021 International Energy Conservation Code Table R402.1.2 Maximum Assembly U-Factors and Fenestration Requirements presents the R-Value requirements of Table R402.1.3 in an equivalent U-Factor format. Users may choose to follow Table R402.1.2 instead. 2021 IECC supersedes this table in case of discrepancy. Additional requirements per §R402 of 2021 IECC must be followed even if not listed here.~~
- ~~11) 2021 International Energy Conservation Code §R401-R404. [Weblink](#)~~
- ~~12) 2021 International Residential Code, Table N1103.6.2(R403.6.2): Whole-Dwelling Mechanical Ventilation System Fan Efficacy. [Weblink](#)~~
- ~~13) Electronic Code of Federal Regulations, 10 CFR Part 430, Subpart C, §430.32, "Energy and water conservation standards and their compliance dates." [Weblink](#).~~
- ~~14) 2021 International Energy Conservation Code Tables C402.4 and C402.1.4. Users may choose to follow Table C402.1.3 instead of Table C402.1.4. 2021 IECC supersedes this table in case of discrepancy. Additional requirements per §C402 of 2021 IECC must be followed even if not listed here. [Weblink](#)~~
- ~~15) 2021 International Energy Conservation Code §C402.5.2 [Weblink](#)~~
- ~~16) 2021 International Energy Conservation Code §C403.12.1. [Weblink](#)~~
- ~~17) 2021 International Mechanical Code, Table 403.3.1.1: Minimum Ventilation Rates. [Weblink](#)~~
- ~~18) 2021 International Energy Conservation Code §C403.3.2. [Weblink](#)~~
- ~~19) Electronic Code of Federal Regulations, 10 CFR Part 431, Subpart G, §431.110. [Weblink](#)~~