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Energy Credits— A New Way to Save In ASHRAE/IES Standard 90.1-2022

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ASHRAE/IES Standard 90.1-2022¹ includes a new prescriptive efficiency requirement called energy credits. These are contained in a new Section 11 that outlines the scope, credit requirements and measures available to achieve the required credits. This article puts energy credits in the context of energy savings progress for Standard 90.1, reviews the history of energy credits and types of measures available, discusses the scope and applicability to different building types and situations, shows the requirements compared to available credits and provides an implementation example.

Benefits of Energy Credits

Energy standards and codes include mandatory requirements that all buildings must fulfill, and a choice between compliance with prescriptive requirements or whole-building or discipline-specific performance paths where equivalent energy performance to the prescriptive path is demonstrated.

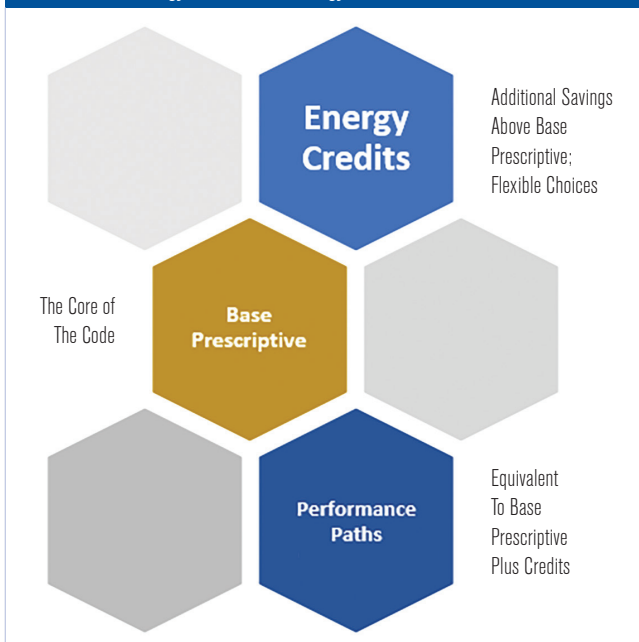
Energy credits are a prescriptive requirement, in addition to the base energy code requirements (*Figure 1*). Energy credits constitute a new prescriptive requirement; however, instead of all measures being required,

the building designer can select from a menu of options to achieve a required level of energy performance. For Standard 90.1-2022, energy credit requirements were established to target approximately 5% increased building energy cost savings.

The Standard 90.1-2022 energy credits build on energy credit approaches in other energy codes and include 26 energy efficiency measures, one renewable energy measure, and seven load management measures. Each measure is assigned a number of credit points based on the anticipated energy cost savings it will achieve.

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FIGURE 1 How energy credits fit into energy codes and standards



Each credit point represents a savings of 1/10 of 1% of total building energy cost. Load management measures base their cost savings on a typical time-of-use electric price structure adopted by Standing Standards Project Committee (SSPC) 90.1. Compliance requires projects to include energy credit measures that achieve a required energy credit point threshold, which varies by building use type and climate zone. The targeted 5% additional energy cost savings in Standard 90.1-2022 translates into needing 50 credit points for most building types and climate zones.

Whole-building performance paths have been adjusted to maintain equivalent energy impact through modifications to the Energy Cost Budget in Section 12 and modification of the building performance factors for compliance with Appendix G.

Pacific Northwest National Laboratory (PNNL) has published a detailed technical support document, "90.1 Energy Credits Analysis Documentation,"² that provides additional detail on the development of energy credits for Standard 90.1. PNNL has also developed an "Application Guide"³ for energy

credits as an additional resource for building designers.

Standard 90.1 Savings Progress

Since its first version in 1975, Standard 90.1 has made significant progress in building energy savings (Figure 2). The last three 90.1 cycles have averaged about 6% to 7% overall energy savings per cycle. The 2022 edition doubled that savings to about 14%, with more than a third of that increase in savings attributable to energy credits.

History of Energy Credits

Energy credits have been adopted in other model building energy codes. Many residential energy codes over the past 20 years have had efficiency requirements that involved a choice of options. In commercial codes, a choice-based efficiency concept first appeared in the 2012 International Energy Conservation Code (IECC) as a "select one of three options" approach. This "pick one" approach evolved over the years to include six options in 2015 and eight options in 2018. The 2021 IECC⁴ expanded to 15 energy credit measures that were assigned points relative to expected savings, allowing measures to be flexibly selected in a combination that achieves at least 10 credit points, which is equivalent to approximately 2.5% energy savings.

A similar credit concept has now been added to Standard 90.1 with a total of 34 measures, and the proposed 2024 IECC is expected to match the expansion

FIGURE 2 Progress in Standard 90.1 energy savings (90.1-2022 results are preliminary).

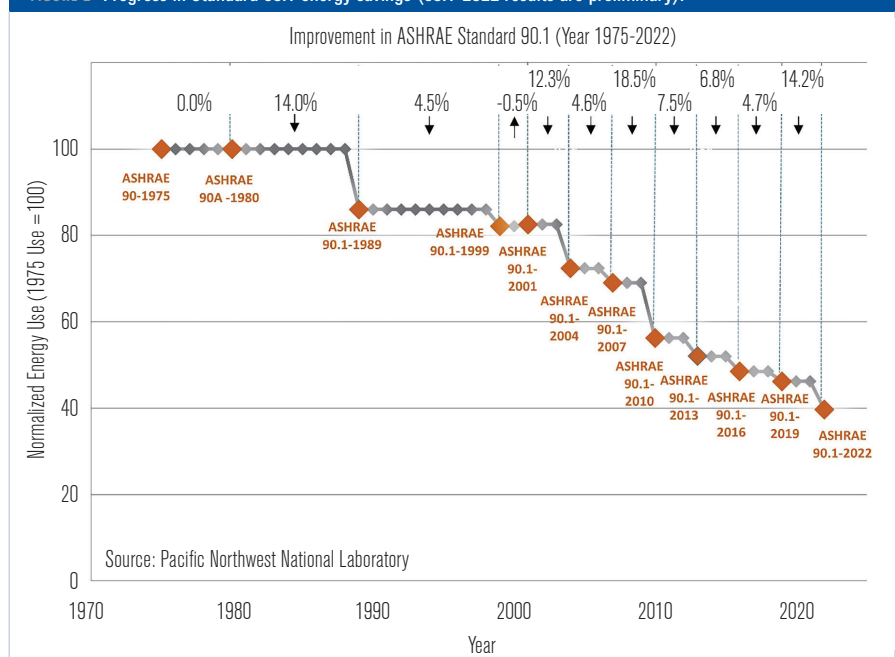
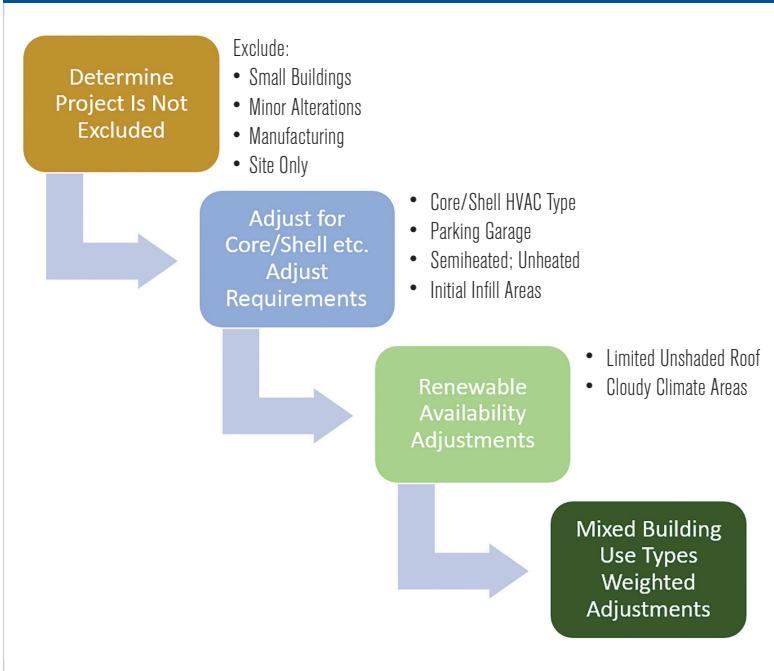


FIGURE 3 General approach to energy credit requirement determination.



of measures. A more complete history of energy credits is included in the “90.1 Energy Credits Analysis Documentation.”²

Standard 90.1 Implementation

The SSPC for ASHRAE Standard 90.1 established a working group that developed a consensus proposal between June 2019 and June 2021. After the public review process, the SSPC adopted energy credits into Standard 90.1-2022. Energy credits were developed from typical efficiency measures used in green building programs, new construction utility incentive programs, and *Advanced Energy Design Guides*.

Energy credits provide additional required prescriptive savings that are more flexible than base prescriptive requirements. The new credit requirement can be met by selecting from a menu of 34 measures. Building designers select from the available measures to meet a savings target above the base prescriptive requirements. Building-type-specific targets were developed with a goal of 5% total building energy cost savings in each climate zone.

Cost effectiveness for energy credit measures was established by demonstrating that at least one package of reasonable measures is cost-effective using the ASHRAE Standard 90.1 scalar method.⁵ The energy credit requirements included in 90.1-2022 were determined to

be cost effective for all building types and climate zones using this approach. More detail is included in Section 2.2 of “90.1 Energy Credits Analysis Documentation.”²

Scope of Energy Credits and Requirement Determination

Section 4 of Standard 90.1-2022 requires that the energy credit requirements be applied to all projects by including Section 11 of Standard 90.1-2022 in the main compliance requirements. In some cases, Section 11 limits the scope or provides exceptions and adjustments to the required credits. The scope and requirement adjustment rules are reviewed in the “Energy Credits Application Guide: ASHRAE Standard 90.1-2022,”³ shown graphically in *Figure 3*, and outlined here:

- Energy credits apply to new buildings and additions larger than 2,000 ft² (186 m²).
 - Alterations greater than 5,000 ft² (465 m²) that have major renovation or replacement of at least two of three building systems (lighting, HVAC or envelope) also have energy credit requirements.
 - Core and shell construction with later tenant build-out have requirements split between the initial building and any later initial build-outs greater than 1,000 ft² (93 m²). The split varies depending on whether HVAC is a central system or completely in the later build-out areas.
 - Site-only projects and manufacturing areas are excluded.

Types of Available Energy Credit Measures

There are two ways to look at the different types of measures: 1) general category and 2) how credit points are determined.

The general categories are:

- **Energy efficiency measures.** These measures reduce the energy use of the building directly—either by reducing the load on the building, through increased system efficiency, or via energy saving controls.
- **Renewable energy measures.** These measures offset metered energy use by using solar, wind or other renewable technologies to generate energy at the building site.

- **Load management (LM) measures.** These measures support the electric grid by allowing the building to adjust electric demand when it will benefit the electric system. Credits for these measures are based on cost savings using a typical time-of-use electric rate schedule or reduced consumer costs. For some load management measures, there may be a small increase in energy use. For others, there may be energy savings in addition to time-related cost savings.

In Standard 90.1-2022, there is an upper limit of 60% of required credits that can be met with the combined renewable and load management credits. This ensures that at least 40% of the credits produce direct energy savings. There is no minimum requirement for LM measures.

There are three categories of energy credits based on how credit points are determined:

- **Credit points are taken directly from the tables.** This applies to many credits. In this case if a design exceeds the minimum measure requirements there is not an opportunity to adjust the number of achieved credit points.
- **Credit points are adjusted based on the installed measure conditions.** This applies to most measures. Good examples are the measures for increased cooling and heating equipment efficiencies (measures H02 and H03), where the measure credit value is based on a minimum 5% improvement over the prescriptive requirement. Both of these measures allow the base credit values to be further adjusted so additional credit can be claimed up to a 20% improvement in heating or cooling efficiency.
- **Credit points are calculated based on building characteristics.** This applies to a few measures including

E01 Envelope Performance and H01 HVAC Performance. These measures are based on simplified building simulation and use a formula to calculate the achieved credit values based on a proposed design's improvement over a prescriptively compliant baseline case.

Measures Available for Energy Credits

The 2022 edition of Standard 90.1 includes 34 measures that can be included in designs to achieve credits. The measure identifiers and abbreviated titles are shown in *Table 1*. Descriptions of the specific requirements to achieve each measure can be found in Section 11 of the standard or the "Application Guide."³ Each measure is assigned points based on expected building savings by building use type and climate zone. Building use types include multifamily, health care, hotel/motel, office, restaurant, retail, education and warehouse. Buildings that are outside those use types are called "other" and have a much lower energy credit requirement. Buildings with a combination of use types meet their requirements using a weighted average of the individual building requirements and credits achieved.

Several of the measures may be applicable in only certain building use types. This occurs where the measure may be common practice already or where the savings are quite low for that building type or climate zone. Measure non-applicability is indicated by an "x" in the measure available credits tables in Section 11.5.3 of Standard 90.1-2022. In mixed-use buildings, each use has credits calculated separately before weighting, as demonstrated in the "Application Guide."³

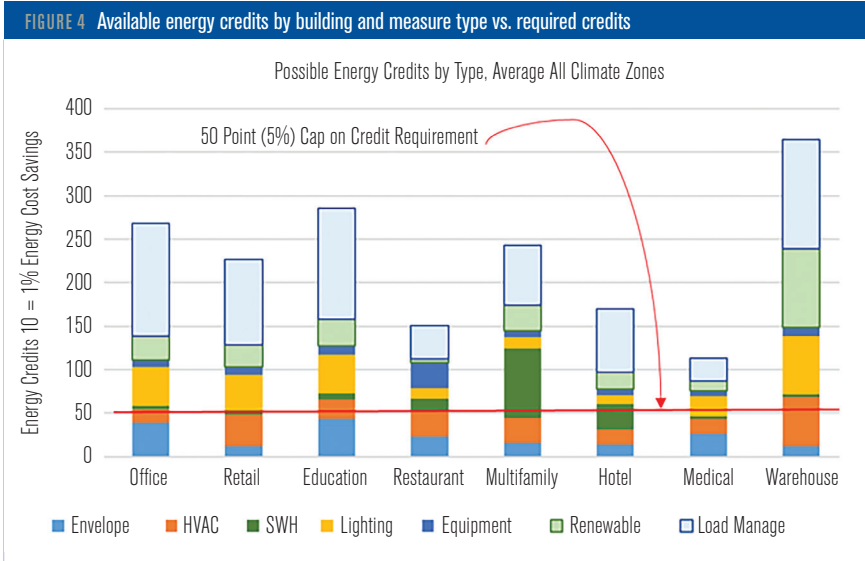
2022 Savings Requirement

The maximum available Standard 90.1-2022 credit

TABLE 1 Energy Credit Measures in 90.1-2022

ENERGY EFFICIENCY MEASURES			RENEWABLE & LOAD MANAGEMENT MEASURES
E01: Envelope Performance	W01: SHW Preheat Recovery W02: Heat Pump Water Heater W03: Efficient Gas Water Heater W04: SHW Pipe Insulation W05: Point of Use Water Heaters W06: Thermostatic Balancing Valves W07: SHW Submeters W08: SHW Flow Reduction* W09: SHW Shower Drain Heat Recovery	L02: Lighting Dimming & Tuning L03: Increase Occupancy Sensor L04: Increase Daylight Area L05: Residential Light Control L06: Light Power Reduction P01: Energy Monitoring Q01: Efficient Elevators Q02: Efficient Kitchen Equipment Q03: Fault Detection	R01: Renewable Energy G01: Lighting Load Management G02: HVAC Load Management G03: Shading Load Management G04: Electric Storage G05: Cooling Storage G06: SHW Storage G07: Building Mass with Night Flush

* Measures H01 and W08 are in the process of being added or adjusted under continuous maintenance since the initial release of Standard 90.1-2022.



points from different measure types for each building use type are compared with the 50-point cap on credit requirements in Figure 4. Generally, the available credit points are much greater than the requirement.

Energy Credit Application Guide

To demonstrate the range of options available to meet the requirement, an "Application Guide"³ has been developed that includes general information about meeting the energy credit requirements in Standard 90.1-2022. Example packages are shown for hot, moderate and cold climates demonstrating nine alternative ways to meet the energy credit requirements for each building use type. There is also a general description of all energy credit measures, including how they save energy or reduce electric grid costs and their general applicability.

In the "Application Guide," several sample packages have been developed for each combination of building type and climate zone group. The goal is to demonstrate a range of combinations that can reasonably meet the credit requirements. Here are descriptions of the sample packages:

- **Cost-Effective Base Demonstration Package.** In a previous analysis,² cost-effective packages of energy credit measures were established for each building type and climate zone. The objective of that analysis was to help guide the determination of energy credit point requirements. Those packages are the basis for the cost-effective base demonstration package in the "Application Guide."³ In some cases, there are slight differences due

to the grouping of multiple climate zone selections into the hot, moderate and cold climate groups.

- **Minimum Equipment Efficiency Demonstration Package.** This package was developed to show a reasonable achievement of the required energy credits without using efficiency improvements for HVAC and service water heating (SWH) equipment subject to The Energy Policy Act⁶ minimum federal efficiencies. This package was selected by using reasonable measures with the same goal of 5% savings; however, HVAC and service water heating efficiency

measures (H02, H03, W02, W03) are not included.

- **Prototype Measure Packages.** A separate package of measures was developed for each of the prototype models that are used to capture the impact of the energy credits as part of PNNL's analysis of the savings of Standard 90.1-2022 compared to Standard 90.1-2019. This package of energy credits is based on the cost-effective demonstration package but has several changes that were made to facilitate accurate modeling. The exact measures included in the prototype simulations will be documented in a future Standard 90.1-2022 energy analysis technical report.

- **Alternative Measure Packages.** Six additional alternative packages are included for each building type and climate to demonstrate different possible ways to meet the prescriptive energy credit requirements. Not all of the alternative packages were applied to every building type and climate. In general, each package has a focus on the measures related to the package title, but there may be additional unrelated measures needed to meet the total energy credit requirements. Alternate packages include:

- Maximizing renewable PV installation;
- Maximizing service hot water efficiency;
- Lighting reduction focus (warehouse only);
- Ground source heat pump implementation (all building types except warehouse);
- Maximizing control improvements;
- Maximizing HVAC efficiency improvements;
- Cooling storage system with improved cooling efficiency (only used for hot and moderate climates);

TABLE 2 Sample hotel evaluation of three alternate packages.

PROJECT: HOTEL EXAMPLE		TABLE POINTS FROM STANDARD 90.1	ALTERNATIVE PACKAGES FOR PROJECT					
			Pack A - SHW		Pack B - Control/Des		Pack C: Mix	
Climate Zone: 4C			Notes & Adj.	Credits	Notes & Adj.	Credits	Notes & Adj.	Credits
Required Energy Credits: 50								
H03	Cooling Efficiency	3					15%/5%	9
H07	Guideline 36 Sequence	2			In DDC	2		
W02	Heat Pump SW Heater	13	30% Load	13				
W03	Efficient Gas SW Heater	10	70% Load, 0.6 Adj.	6				
W06	Thermostatic Balancing Valves	1	Yes	1				
W08	SHW Distribution Sizing	9			Low Flow	9		
L02	Lighting Dim & Tuning	2			Common	2		
L03	Added Occupancy Sensors	5			Auto Off	5		
L06	Lighting Power Reduction	3					10%	6
R01	Renewable Energy	10					0.3 W/ft ² PV	30
Q01	Efficient Elevators	4					All Class A	4
Q03	Fault Detection	2			In DDC	2	In DDC	2
G06	SHW Storage	31	Yes	31	Yes	31		
A:	Raw Sum of All Credits Achieved			51		51		51
B:	Renewable (R) + Load Management (G)			31		31		30
C:	Renewable + Load Management Limit: 60% × Required			30		30		30
Total Credits Achieved (A - B) + {lesser of B, C}				50		50		51

- Reduced heating loads with improved heating efficiency (only used for cold climates).

Sample Package Evaluation

To demonstrate how projects might meet the energy credit requirement, an example is completed for hotels in Climate Zone 4C. This selection is made because this combination has a higher required-to-available point ratio for the moderate climate. Only measures used in the example are shown in Table 2. In the table, three alternative credit packages are shown that each meet the 50-credit requirement.

When looking at a particular building, sample packages can be reviewed by building type and general climate in the "Application Guide."³

Conclusion

A new Section 11 has been added to Standard 90.1 to increase energy savings by requiring energy credit measures beyond the base prescriptive requirements. This new requirement targets a 5% reduction in overall building energy cost through selection from a broad range of measures. Allowing designers to choose measures

that are particularly suited to a particular project provides flexibility in increasing energy savings. There are resources available to help designers implement this new requirement in Standard 90.1-2022, including an "Application Guide."³

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