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August 3, 2026

The Honorable Audrey Roberston
Assistant Secretary, Office of Critical Minerals and Energy Innovation
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

Re: ASHRAE Response to RFI on Updating and Improving the Methodology for Assessing Affordability and Cost-Effectiveness of Building Energy Codes (May 4, 2026)

Submitted electronically through the Federal eRulemaking Portal at http://www.regulations.gov

Dear Assistant Secretary Roberston:

Thank you for the opportunity to provide input on the May 4, 2026 Request for Information (RFI) issued by the U.S. Department of Energy's (DOE's) Office of Critical Minerals and Energy Innovation entitled, "Updating and Improving the Methodology for Assessing Affordability and Cost-Effectiveness of Building Energy Code." We appreciate DOE's efforts to find ways to improve affordability in housing and new construction, along with increasing transparency and participation in the energy standards and code development process. We hope to work with DOE to improve the analysis of building energy codes so that they can bolster the resiliency of our nation's buildings, save operational energy expenses for consumers and the government, and strengthen our energy grid.

ASHRAE, founded in 1894, is a professional and technical society of more than 55,000 members who focus on building systems, energy efficiency, indoor air quality, refrigeration, and resiliency. Through research and improved technology, standards writing, publishing, certification and continuing education, ASHRAE shapes tomorrow's global built environment today. ASHRAE is actively engaged in the development of robust, voluntary, ANSI approved consensus-based standards and is one of only seven standards-developing organizations in the U.S. that can self-certify that its standards have followed procedures established by the American National Standards Institute (ANSI). ASHRAE has been at the forefront of developing technical resources and training, including energy consensus-based standards for residential and commercial buildings for over 50 years.

ANSI/ASHRAE/IES Standard 90.1, *Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings* ("ASHRAE Standard 90.1") is the benchmark for commercial building energy standards and codes in the United States and has been a key basis for codes and standards around the world for more than 50 years.

ASHRAE's most recently published ASHRAE Standard 90.1-2025 incorporates over 100 approved addenda since the publication of the 2022 edition and reflects a process by which ASHRAE received 400 comments from 115 distinct commenters over the course of a three-year period. All proposed changes to ASHRAE Standard 90.1 are open for public review, which allows interested parties to provide input and participate in the development of the standard and reach consensus, ensuring publication of a document that has been rigorously and openly been examined, questioned, and defended.

ASHRAE's consensus process ensures broad buy-in and reflects input from building owners, design professionals, utilities, manufacturers, energy advocates, representatives from DOE, and other materially affected and interested parties. Organizations with permanent seats on the committee include the Building Owners and Managers Association (BOMA), the National Association of Home Builders (NAHB), and the American Gas Association (AGA). Based on analysis conducted by DOE, compared to a building built using ASHRAE Standard 90.1-2004, a building built to ASHRAE Standard 90.1-2022 will use nearly half the energy. Compared with the 2019 version of Standard 90.1, DOE estimates that Standard 90.1-2022 achieves site energy savings of 9.8%, source energy savings of 9.4%, and an overall energy cost reduction of 8.9%. The committee that oversees the development of this standard, Standing Standard Project Committee 90.1 (SSPC 90.1), has done an amazing job of receiving broad input and developing consensus standards of improved performance for over 50 years.

ASHRAE welcomes DOE's goal of improving the technical analysis to quantify consumer cost impacts associated with building energy codes, including Standard 90.1. ASHRAE SSPC 90.1 has a long history of collaborating with DOE and supporting national laboratories to develop proposals and to conduct energy and cost-effective analysis. Below is ASHRAE's input to the specific issues for which DOE is seeking feedback, organized by the topics identified in Section III of the RFI.

Q01. Costs to Consumers: Suggestions for cost data and other considerations that more accurately reflect the real market costs paid by consumers.

In ASHRAE's analysis of cost-effectiveness for Standard 90.1, building component and building equipment cost changes are included as well as shipping, installation, service, and distribution costs, i.e. the final cost to the "consumer" building owner. Where possible, ASHRAE SSPC 90.1 uses publicly available cost like RSMeans, which is used by the industry for building cost estimates. The committee tries to avoid the use of absolute cost as this can cause issues with legal concerns for price fixing (anti-competitiveness), which may run afoul of the Sherman Antitrust Act. Instead, the committee will use delta cost changes as much as possible using the incremental cost increase analysis for the incremental efficiency change. The cost increase to the end user or customer is determined for the incremental increase in efficiency. To do this, the committee often makes use of blind surveys of manufacturers of the building component or equipment to determine incremental first cost. It then has third-party organizations like AHRI combine the data and provide the data to ASHRAE with the removal of any tie to individual manufacturers or proprietary products. The committee believes this is a good approach as the manufacturers know the technology and cost, and can reflect incremental material, burden and labor costs that may not be

publicly available. Volume of production and capital expenses can also have a significant impact on costs due to the level of tooling and manufacturing approach.

ASHRAE always strives to use accurate and representative costs which can be complicated as we approach "max tech", and as the industry addresses other changes like refrigerant changes for compliance with EPA and Kigali requirements that can have a significant impact. For example, additional costs had to be added to products for the changes from A1 to A2L refrigerants due to the additional sensors and flammability mitigation. The A2L change did not improve efficiency, but was implemented at the same time as efficiency changes and was reflected in the price to consumers. The next refrigerant change expected in the 2034-time frame will also add additional product cost, which the committee intends to incorporate into its cost analysis.

The accurate determination of energy costs and savings is essential in cost analysis. ASHRAE's cost analysis is generally based on U.S. average energy rates; however, the committee also uses time of use rates. Also, when a potential change being evaluated is just at the scalar limit (cost to savings ratio), they will conduct additional analysis using local energy rates instead of average energy use rates to understand those impacts. Often the actual scalar ratio is well below the scalar limit except for extreme hot climate zones for heating, and cold climate zones for cooling. Average US energy rates are developed every three years and are documented in the ASHRAE Standard 90.1 work plan and approved by the ASHRAE 90.1 consensus committee (SSPC 90.1). The committee's modeling uses all 19 climate zones in ASHRAE Standard 169 based on the reference cities that ASHRAE 90.1 has developed.

A key part of the committee's cost analysis is the modeling of equipment and building components which are often approximated by modeling approaches. With the focus on annualized performance and new metrics like SCORE, SHORE, IVEC, IVHE, ISMRE2, properly modeling equipment and components is critically important, and ASHRAE welcomes engagement by DOE in improving this modeling. ASHRAE has been working on new standardized approaches for equipment modeling with the new ASHRAE Standard 205 *Representation of Performance Data for HVAC&R and Other Facility Equipment,* approaches for which DOE has been providing support. Completing the development of these models will enhance both accuracy and productivity. Also, new simplified procedures like Total System Performance Ratio (TSPR) and a visual modeling tool (a proposal for which the industry has been advocating) would help considerably and could use additional assistance from DOE and its National Labs.

The committee would be glad to provide a detailed briefing to DOE on its cost procedures, modeling, energy analysis, data inputs, as well as new initiatives like ASHRAE Standard 205 and simplified modeling approaches using the 16 reference buildings. ASHRAE welcomes further discussion on the committee's cost procedures and ways to collect improved cost and other data that more accurately reflect real market costs and consumer impacts.

Q02. Cost Database: The appropriateness of developing and maintaining a publicly available database that estimates real market costs to consumers from building energy codes.

ASHRAE SSPC 90.1 follows a rigorous process to come to consensus on the incremental price inputs for efficiency changes for the standard cost effectiveness analysis. For each three-year code cycle, ASHRAE SSPC 90.1 updates energy costs to reflect the most recent historical, current, and projected cost data. This is part of the scalar procedure explained in our response to Q08, as well as Attachment A, and includes consideration of loan rates, discount rates, inflation, and local utility energy pricing. DOE and its labs provide assistance with these rates and pricing, including through use of the Cambium Data Base (electrical grid consumption and projections model), to ensure that the costs reflect best available data.

As previously mentioned, the preferred approach is to use incremental product costs and prices. ASHRAE SSPC 90.1 does not believe that a centralized cost database would be beneficial and could have anti-competitive impacts due to concerns with price fixing that might violate the Sherman Antitrust Act. We recommend that absolute cost not be used. Instead, delta costs for efficiency changes should be used along with procedures like blind surveys to establish representative first cost changes. It is better to get the data from manufacturers who know the technology, manufacturing processes, tooling, burden and other factors like installation and service. Technology is also changing rapidly. As we approach "max tech," costs can quickly increase and are hard to estimate using historical data. There also can be secondary costs related to installation or use of specific equipment or building components that need to be included. For example, for packaged rooftop air handling units, if the size increases, it can result in the use of conversion curbs for the large retrofit and replacement market. There are also other considerations like refrigerant changes and environmentally driven material changes that can impact costs. A centralized cost database would not streamline nor speed the process and could have anti-competitive impacts. We do recommend use of cost delta approach, where possible, and not absolute costs. ASHRAE SSPC 90.1 would be glad to walk through the procedures used for energy cost as well as first cost and the details of the ***scalar ratio.***

Q03. Regional Differences: The appropriateness of considering regional differences when evaluating real market costs to consumers and suggestions for data that demonstrate regional differences.

ASHRAE SSPC 90.1 conducts a rigorous technical consensus process to establish energy costs and energy savings which is documented in the work plan and is updated every three years. As the committee is now working on the next update to Standard 90.1 for 2028, it established these cost metrics for energy costs, time of use rates, and scalar limit data inputs at their meetings during the ASHRAE Winter Conference in Las Vegas on January 31, 2026. The votes below reflect an extremely robust consensus on the process, data inputs and resulting costs across the many parties and industries represented at SSPC 90.1:

- Fuel costs (including electricity) were approved with 43 yes votes, zero no votes and two abstentions
- Time-of-use electricity rates were approved with 42 yes votes, zero no votes and one abstention

ASHRAE always conducts regional energy analysis using the appropriate reference commercial and residential buildings or buildings for all 19 climate zones using the reference cities. These are done using average US energy costs. In most cases the calculated ***scalar ratio*** does not approach the ***scalar ratio limit,*** but for cases where the ***scalar ratio*** is close to the ***scalar ratio limit*** the committee will sometime use local energy costs or time-of-use cost to evaluate viability of the change. Where the scalar ratio limit is questionable, a building and climate zone may be exempted from requirements except for HVAC equipment efficiencies that are also regulated by DOE where the EPACT limits the requirements to one national US energy metric.

If DOE has proposals on how to further subdivide the 19 climate zones and combine with E-GRID, ASHRAE SSPC 90.1 would be glad to have that conversation.

Q04. Economic Benefits to Consumers: Suggestions for data and analysis approaches that more accurately reflect economic benefits to consumers.

As mentioned in other comment responses, ASHRAE SSPC 90.1 uses the *scalar ratio* procedure which is documented in the committee's standard work plan (see Attachment A). This approach reflects the economic cost effectiveness and benefits to consumers/building owners. Additionally, the consensus process considers other factors such as technical feasibility, practicality, and product availability in setting final criteria, and does not always drive to the maximum possible scalar limit as is often the case with life cycle cost analysis. That means the change will provide more flexibility or economic benefit for consumers.

Updates and expansion to reference buildings will help ensure the economic benefits are properly accounted for by different building types and use scenarios (also see response to Q06). ASHRAE SSPC 90.1 has a working group that updates the reference buildings, including through receiving input from other industry model experts. The committee is also trying to expand the reference buildings and plans to add a Supermarket. DOE assistance could help with this effort to add additional reference buildings that the working group has identified and prioritized.

Ongoing work on ASHRAE Standard 205, *Representation of Performance Data for HVAC&R and Other Facility Equipment*, aimed at improving equipment modeling standards and developing new simplified visual modeling tools could also help advance this effort. We welcome DOE's assistance with refining and updating ASHRAE Standard 205. In addition, the industry is trying to develop a modeling tool and procedures that could help reduce the analysis conducted by volunteer members of ASHRAE SSPC 90.1. Support from DOE could enable development of a tool like this to move forward, increasing the productivity of the committee.

We would like to note that not all changes to Standard 90.1 are made for energy savings. Changes made to address human comfort or address indoor air quality (i.e., ventilation and humidity control to prevent growth of mold) are also included in Standard 90.1, and these are also important to consumers and users.

Q05. Utility Costs and Energy Metrics: Suggestions for data and metrics on energy costs that more accurately reflect costs paid by the consumer and the appropriateness of considering regional differences in energy costs for national-level analyses.

As mentioned in other question responses, ASHRAE SSPC 90.1 develops US weighted average energy costs based on commercial rates, including flat rates and time-of-use rates. SSPC 90.1 also develops optional time-of-use average use rates that will likely be used more with the increased use of renewable energy, energy storage, and SmartGrid adoption. The table below documents what was developed for the 2025-2028 cycle, as well as prior years.

Energy Cost	2010	2013	2016	2019	2022	2025	2028p	Delta 25-28
Blended Heating ($/therm)	1.22	0.99	1.02	0.98	0.983	1.074	**1.2474**	16.1%
Natural Gas ($/therm)				0.8243	0.8021	0.8381	**1.0452**	24.7%
Heating Oil ($/gal)				2.6849	2.9275	2.9508	**3.4981**	18.5%
Cooling/Electricity ($/kWh)	0.0939	0.1032	0.1013	0.1063	0.1099	0.1122	**0.1316**	17.3%

ASHRAE SSPC 90.1 also has developed average time of use rates as shown below.

Season	Winter	Summer
Applicable Months	Jan. – May Oct. – Dec.	June – Sept.
per kWh during On-Peak hours	$0.0640	$0.0940
per kWh during Off-Peak hours	$0.0510	$0.0510
Monthly Demand Charge	$10.12 / highest kW on-peak $5.77 / highest kW all-hours	$14.40 / highest kW on-peak $6.81 /highest kW all-hours
On-Peak Period:	M-F Energy: 6 am – 10 am and 4 pm – 9 pm Demand: 4 pm – 9 pm	M-F Energy and Demand: 12 pm – 9 pm
Off-Peak Period:	All other hours	All other hours

ASHRAE SSPC 90.1 has discussed documenting local E-Grid Rates, but the E-Grids do not align with the climate zones so it would be complicated. ASHRAE SSPC 90.1 would be willing to have further discussions with DOE on how to accomplish this.

In most cases where the scalar ratio is not close to the scalar ratio limits, local analysis is not needed. Where it is close, a proposed exception method should be considered using documented local rates. It would be helpful if DOE were willing to assist the ASHRAE SSPC 90.1 economics working group to develop the local rates for both standard rates and optional time of use rates. Additionally, the performance-based compliance paths in

Section 12(Energy Cost Budget method), Appendix C (Envelope trade-off option), and Appendix G (Performance rating method) either require or allow the use of local purchased energy rates for the specific project, thus providing local / regional evaluation rather than just national average rates.

Q06. Suggestions for adding new or reconfiguring existing prototype buildings to better evaluate affordability and reflect the makeup of the housing and buildings market.

ASHRAE SSPC 90.1 has been working with PNNL for the past 6 months to evaluate the current 16 reference prototype buildings using considerable feedback from members and industry guests. (Note that these buildings are also used to develop Building Performance Factors (BPF) for modeling compliance options.)

This work has resulted in a list of recommended changes. Additional support from DOE would enable these changes to be successfully implemented so they can be used for on-going analysis. The same working group has also investigated additional buildings and developed the following list of possible additions.

Building Type	Area Based Weights	Estimated EUI kBtu/sf	EUI Based weights
Parking Garage	9.9%	4	0.9%
Supermarket (in development)	0.8%	200	3.7%
Refrigerated Warehouse	0.4%	250	2.4%
Laboratory	0.6%	250	3.5%
Data Center (90.4)	0.6%	1,869	25.1%
Indoor Growing Facility	0.2%	823	2.9%
Light Manufacturing	3.8%	50	4.2%
Higher Education	1.7%	28	1.0%

The ASHRAE 90.1 committee selected Supermarkets as the next priority, but the other prototype buildings are clearly also of interest, especially data centers. Since data centers are changing so quickly, defining a representative model may be difficult. To tackle this issue, ASHRAE SSPC 90.4 Energy Standard for Data Centers is working on a spreadsheet modeling compliance tool and developing a data center prototype that would be useful for this tool. We welcome further engagement from DOE to develop and refine these additional prototypes and tools.

Q07. The appropriateness of considering additional metrics that better demonstrates expanded impacts on consumer affordability, consumer choice, and purchasing power.

ASHRAE, as well as other organizations, support the development of new equipment efficiency metrics that are more representative of the annualized efficiency of the products as applied in buildings. This includes some of the new metrics for commercial unitary including Integrated Ventilation Efficiency Coefficient (IVEC), Integrated Ventilation Heating Efficiency (IVHE), Seasonal Cooling and Off-Cycle Rated Efficiency (SHORE), and a dual fuel version of IVHE. Similar work was also done for light commercial unitary with the new SCORE and SHORE but the implementation of

these new metrics and test procedure has been delayed. Additional work for new expanded annualized representative metrics should also be explored for other products. We welcome continued support for development of these metrics, which can better demonstrate expanded impacts, including on consumers.

Q08. Cost-Effectiveness Approach: Input on appropriate discount rates and potential thresholds for payback periods and suggestions for updating existing cost analysis approaches or utilizing new approaches.

ASHRAE SSPC 90.1 always conducts cost effectiveness analysis where a proposed change is more than editorial and language revisions. This is done using the ***scalar ratio*** procedure as mentioned in the RFI and more thoroughly described in Attachment A. Analysis is done for all 19 climate zones as defined in ASHRAE Standard 169 using appropriate reference buildings jointly developed with PNNL and climate zone reference cities.

ASHRAE 90.1 also has procedures and documentation on energy analysis and cost-effective analysis which is required to be addressed in every addendum and shared during public review. ASHRAE 90.1 uses a ***scalar analysis*** which uses a ***scalar limit,*** which is equivalent to the net present value of the life cycle for the technology and accounts for loan interest rates, discount rates, and inflation. The life of the product or building component is used where, for example, the building may be in service for 40 years, but the life of the building component may be different. For mechanical equipment, the life of the product is defined in the ASHRAE handbook and for typical unitary air conditioners is 15 years. The payback for the annualized energy cost savings compared to the cost of the change using a payback ratio (scalar) is compared to the scalar limit. The cost of the changes includes first cost, installation cost, service cost, and other factors as needed. This analysis is done regionally using the 19 climate zones in ASHRAE Standard 169, the 16 reference buildings, and 19 reference cities that ASHRAE 90.1 has developed for each of the 19 climate zones. ASHRAE SSPC 90.1 documents this in the work plan, which we would be glad to review with DOE.

ASHRAE welcomes DOE's goal of improving the technical analysis to quantify consumer cost and building owner (user) impacts associated with building energy standards, including Standard 90.1. This can include updates to the reference buildings, better component and equipment models (which ASHRAE is working on with the ASHRAE Standard 205 committee) and the development of new tools that can help the committee analyze complex building energy use.

ASHRAE SSPC 90.1 uses an economics working task group to develop economic inputs which include discount rates, inflation rates, and load rates which are incorporated into the scalar calculation procedure. The group includes representatives from each subcommittee as well as PNNL. The table below shows the current and past rates that have been used. ASHRAE SSPC 90.1 voted to approve these rates for 2025-2028 cycle. These factors then result in a table of scalar limits based on the lifetime of the building component being evaluated (also see Q09). The committee would be glad to have further discussions with DOE regarding the rates used for the 2025-2028 cycle.

Economic Factors used for Scalar

Scalar Factor	2010	2013	2016	2019	2022	2025	**2028**	Delta 25-28
Loan Interest Rate (%)	7.0%	6.25%	7.0%	5.0%	5.0%	4.9%	**7.2%**	46.9%
Discount Rate (%)	7.0%	7.05	9.345	8.505	8.15	7.85	**8.715**	11.9%
General Rate of Inflation (%)	3.7%	2.49%	2.38%	2.06%	2.33%	2.28%	**2.54%**	11.4%

For the threshold on payback, ASHRAE SSPC 90.1 uses the scalar ratio limit which is equipment costs divided by the net present value of the lifetime payback period. This calculation uses the economic factors in the table above and the estimated life of the product or technology, which is what DOE uses for new HVAC efficiency proposals. However, the estimated product life that ASHRAE SSPC 90.1 uses is generally less than what is estimated by DOE studies, and is based on the ASHRAE handbook. Details are included in Attachment A

Q09. Evaluation Period: Suggestions for data and studies that demonstrate the appropriate length of time that is applicable to energy efficiency measures, and better methods of evaluating benefits to consumers.

For commercial buildings, the ASHRAE scalar ratio method establishes different scalar limits based on the lifetime of the building component being evaluated. For example, equipment like unitary rooftop air conditioners have a 15-year product life, water cooled centrifugal chillers have a 23-year life, and building envelope upgrades like insulation or windows are more likely to be viewed on a 30- or 40-year time horizon based on the accepted longevity of the respective measures. For mechanical equipment, ASHRAE SSPC 90.1 uses the values in the ASHRAE Handbook but we are considering additional refinements through an ongoing ASHRAE project that is gathering data on equipment life. These scalar ratios are then translated into a scalar limit as shown in the Scalar Ratio table below.

DOE traditionally evaluates the economic impact of residential and commercial buildings over 30 years, which is consistent with recommendations and data from the National Institute of Science and Technology (NIST) and OMB. For mechanical equipment, DOE has been using 18 years to as high as 30 years for some of their Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) evaluations.

Scalar Ratio Limit 2025-2028 Standard					
Year	SR_H	SR_C	Year	SR_H	SR_C
1	0.9	0.9	26	14.7	14.1
2	1.8	1.8	27	15.0	14.3
3	2.7	2.7	28	15.3	14.6
4	3.5	3.5	29	15.5	14.8
5	4.3	4.2	30	15.8	15.0
6	5.0	5.0	31	16.0	15.2
7	5.8	5.7	32	16.2	15.4
8	6.4	6.3	33	16.4	15.6
9	7.1	7.0	34	16.6	15.8
10	7.7	7.6	35	16.8	15.9
11	8.3	8.2	36	17.0	16.1
12	8.9	8.7	37	17.2	16.2
13	9.5	9.2	38	17.3	16.4
14	10.0	9.7	39	17.5	16.5
15	**10.5**	**10.2**	**40**	**17.6**	**16.7**
16	11.0	10.6	41	17.7	16.8
17	11.4	11.1	42	17.9	16.9
18	11.9	11.5	43	18.0	17.0
19	12.3	11.9	44	18.1	17.1
20	12.7	12.2	45	18.2	17.2
21	13.1	12.6	46	18.3	17.3
22	13.4	12.9	47	18.4	17.4
23	**13.8**	**13.2**	48	18.5	17.5
24	14.1	13.5	49	18.6	17.5
25	14.4	13.8	50	18.7	17.6

However, DOE also recognizes that homeowners often make investment decisions on a shorter time frame, and that homeowners own their home for an average of 12 years, although tenures vary widely across the U.S.[1] Older homeowners frequently remain in their homes for 20+ years. Forty percent (40%) of baby boomers have lived in their current home for at least 20 years. The typical commercial real estate owner holds a property for approximately 5–10 years before selling, recapitalizing, or refinancing it. Institutional investors often target holding periods in this range to realize appreciation and meet return objectives. The average expected life expectancy of commercial buildings is shown in the Building Type table below.[2]

Building Type	Typical Physical Life
Office buildings	50–100+ years
Warehouses	40–80+ years
Retail centers	40–70+ years
Hospitals	50–100+ years
Data centers	20–40 years before major modernization, though structures may last much longer

The appropriate evaluation period for determining the economic life in energy efficiency standards has long been a topic of discussion. In the past, the focus of standards and DOE efficiency regulations was to set standards that would move buildings to higher efficiency

[1] Source: National Mortgage Professional, March 3, 2026, "Owners Staying Longer, Locking Up Inventory." https://nationalmortgageprofessional.com/news/owners-staying-longer-locking-inventory. Accessed July 29, 2026.
[2] ASHRAE 2015 Systems Handbook Table 4.

with a focus on changes that would pay back in the life of the product or building. Often consumers and users have shorter timelines, but the policy focus was to move buildings to higher efficiency. The appropriate evaluation timeline should be set using rigorous data and with clear and transparent policy aims, whether they are for short-term or long-term affordability, energy conservation, and/or a strong and resilient energy grid.

A potential strategy for increasing the adoption of energy efficiency measures is to finance the cost of efficiency improvements through mortgages or other lending mechanisms. Several financial institutions have begun exploring this concept, and it should be evaluated further for both residential and commercial properties. In particular, interest is growing from investment firms to improve energy efficiency so the time could be right to have further discussions on energy efficiency capitalization and funding to move to longer-term approaches and not put the full burden on the consumer and user. ASHRAE would be glad to work with DOE to explore new energy efficiency financing options and incentives.

Q10. Transparency in Industry Consensus Processes: Feedback on greater transparency and consumer representation in code development processes.

Transparency in the Standard 90.1 Process

As noted in the other responses, ASHRAE's consensus standards are developed through the participation of all interested and affected stakeholders. Participants do not need to be ASHRAE members. ASHRAE Standard 90.1 is an ANSI approved standard that follows ANSI procedures for public review and membership. In addition, all proposed changes and committee meetings for ASHRAE Standards are open for public review, which allows interested parties to provide input into development of the standard and reach consensus resulting in a standard that has been rigorously and openly examined, questioned and defended. Per ANSI requirements, the committee reaches out to the commenters, allows them to address the committee, and all public review comments are addressed and responded to by the committee. ASHRAE also seeks input from ASHRAE technical committees and other interested parties to help develop the proposals for the next iteration of the standard

ASHRAE makes use of an easy-to-use on-line Public Review Portal (link: Public Reviews - Public Review Drafts). Through this portal, commenters can review proposed addenda change public review documents and submit comments as well as receive responses to their comments. The same portal can also be used for submitting proposed changes.

ASHRAE SSPC 90.1 also uses a listserv to notify people of meetings and all meetings are open to the public. There are opportunities for people to request time to address the committee. The listserv can easily be accessed at the following link: Listserves.

The committee also conducts training at the request of users and at each three-year cycle, the committee will review changes to the standard at ASHRAE semi-annual meetings. Starting with the 2022 standard, ASHRAE SSPC 90.1 has published ASHRAE *Journal* articles, and for the 2022 edition, the committee published the following articles which are available for people to access through multiple channels.

ASHRAE *Journal* articles authored by SSPC 90.1 for the 2022 edition		
Number	Date	Description
Part 1	May-23	Changes to Envelope Requirements.
Part 2	June-23	Thermal Bridging Requirements
Part 3	July-23	Mechanical Updates
Part 4	August-23	Energy Credits
Part 5	September-23	Lighting and Power Updates
Part 6	October-23	Mechanical TSPR
Part 7	November-23	ECB Updates
Part 8	2025	AHJ Update

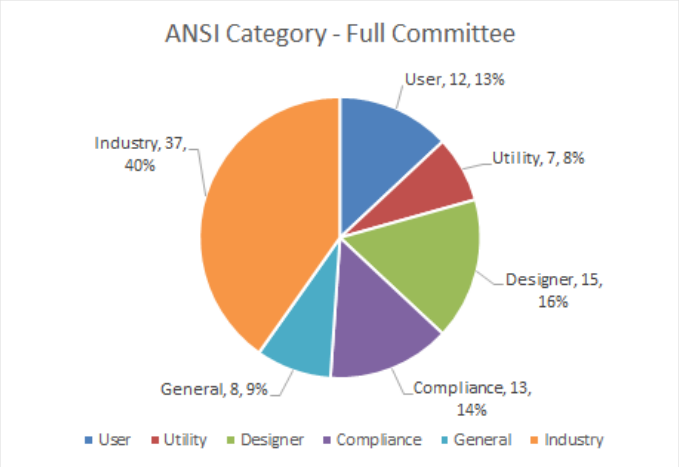
Representation on the Standard 90.1 Committee and Input by Stakeholders

ASHRAE Standard 90.1 is an ANSI approved standard and follows the requirements of ANSI for membership and balance as well as public review and comments. The committee is composed of volunteer members in 5 voting subcommittees with 50 full committee voting members, an additional 18 subcommittee voting members, along with 74 consultants that provide important perspective and help with the development of change proposals. ASHRAE also makes use of designated reviewers and ASHRAE Technical Committees (TCs) for topic-specific proposals to help develop and refine the proposals. ASHRAE SSPC 90.1 has many members who have been involved for decades in the standard development process, and have significant expertise in building and equipment design, applications, local codes and permitting, building operation and standards use. The members and consultants are categorized using the ANSI Categories of user, producer and general that are further expanded by ASHRAE as shown below.

- **User:** A person, organization, or system that interacts with or utilizes a product, system, service, or facility for its intended purpose.
- **Utility:** An organization, entity, or service provider that supplies essential public services—such as electricity, gas, water, or thermal energy—to customers or end users.
- **Designer:** The individual, firm, or organization responsible for the design of a system, product, component, or facility, including its configuration, specifications, and performance requirements.
- **Compliance:** Government entities (AHJs) that have building code and permitting authorities; these individuals have expertise in conforming to applicable requirements specified in a standard, code, regulation, or specification.
- **General:** A classification of users representing the broad, non-specialized population expected to interact with a product, system, or facility under normal conditions, without assuming advanced training, expertise, or professional qualifications.

- **Industry:** A person or organization that utilizes a product, system, or service within an industrial, commercial, or professional context, typically possessing domain knowledge, training, or operational responsibility.

The figure below shows the balance of members and consultants per the ASHRAE expanded ANSI categories.



We understand DOE is focused on consumer representation in the code development process. For ASHRAE 90.1, commercial buildings other than high rise residential, the "consumer" is typically the owner who can be an individual for small buildings, a company or organization for large buildings, or a real estate holding company who then rents the buildings to tenants and where in most cases the tenant then pays the energy costs. Although ANSI does not have a consumer category, we do have members who represent commercial building owners, and who are typically classified as Users. ASHRAE SSPC 90.1 also has members that are from consulting and architectural firms that have clients who are building owners. The committee also includes code officials responsible for enforcing regulations.

As you can see in the figure above, ASHRAE SSPC 90.1 is comprised of 13% of members that are categorized as "Users," which is the closest category to consumers. Additionally, ASHRAE SSPC 90.1 also has 11 organization members from national organizations like AHRI, BOMA, DOE and others, reflecting a large portion of the commercial building market. Many of the individuals and organizational members on the committee have affordability concerns for commercial buildings. We would welcome DOE's assistance in identifying additional organizations and individuals who would best represent the consumer/user perspective.

Ability to Participate in the ASHRAE Standard 90.1 Development Process

ASHRAE recognizes that participation in our standards development process can be daunting to a non-technical participant and to stakeholders with multiple demands on their time. ASHRAE believes that holding stakeholder forums, including through focus groups, can supplement the valuable input received through our traditional ANSI-based standards development processes.

In December 2025, ASHRAE's Residential Buildings Committee convened a stakeholder group comprised of approximately 60 individuals, including industry leaders, technical experts, product manufacturers, builders, and consultants. The purpose of this workshop was to provide actionable insights on residential building challenges and solutions, and ASHRAE gleaned valuable input from holding this workshop. ASHRAE Standard 90.1 could similarly convene a stakeholder group of consumers impacted by ASHRAE Standard 90.1.

ASHRAE would also welcome assistance from DOE in organizing such a stakeholder convening, including through outreach, meeting coordination, and summarizing input received. DOE could assemble the input received through such stakeholder focus groups and develop proposals it could bring to SSPC 90.1 through the ANSI process. DOE might also consider including ASHRAE at annual DOE conferences to participate in forums. This would allow the consumer perspective to not only be received, but with DOE's technical assistance, the consumer perspective could be reflected in standards proposals that can be appropriately considered through the ANSI process by ASHRAE SSPC 90.1.

Potential Alternatives

For all of the reasons outlined in this response to DOE's RFI, ASHRAE strongly discourages any alternative to ASHRAE Standard 90.1.

ASHRAE does want DOE to be aware of a recent ASHRAE effort to develop a new residential standard that it is developing with the proposed title, "Standard for Minimum Energy Requirements for Low-Rise Residential Buildings." The purpose of this standard is to provide cost-justified minimum requirements for the energy-efficient design and construction of new residential buildings three stories or less above grade and for major renovations to existing residential buildings three stories or less above grade, considering first costs, economic impacts, and expected energy savings. This standard is intended to provide performance and a simple, prescriptive path to achieve the objectives for a minimum standard which balances first cost and operational costs for an affordable housing solution. This proposed standard may serve as an alternative to the IECC and would follow the procedures and best practices used for the development and maintenance of the ASHRAE 90.1 commercial standard.

Q11. Permitting Delays and Localized Regulatory Costs: Input on broader issues of regulatory burden caused by permitting delays and localized regulatory costs.

DOE accurately highlights several other issues that impact housing and building construction, including permitting processes, zoning restrictions, and land-use regulations. ASHRAE appreciates DOE further investigating these other factors that can increase housing and building costs and that can delay the benefits from new cost justified energy savings ideas.

Tools like COMcheck developed by PNNL through DOE funding, can also help with state and city code adoption and continued improvements to these tools would be of value. At various times, ASHRAE SSPC 90.1 and its subcommittees have discussed development of 'TurboTax-like' tools that would ease both compliance and enforcement for users.

Training and *ASHRAE Journal* articles can also help reduce delays by improving information dissemination, and ASHRAE would be pleased to provide any additional briefings or information sessions to reduce delays and compliance costs. ASHRAE would be willing to work with DOE on other ways to break down adoption delays and approvals through training and best practice sharing. AI compliance tools hold great promise for reducing regulatory burdens and permitting delays.

Q12. Suggestions for drivers and data sources for broader costs of new construction for residential and commercial buildings.

The cost of construction materials has continued to climb. The June 11, 2026, U.S. Bureau of Labor Statistics Producer Price Index reported that the prices of construction materials are 9.6% higher than a year ago. Homeowner insurance costs have also surged, with an increase of 24% between 2021 and 2024 reported by the Consumer Federation of America.[3] The U.S. Treasury found in a report last year that average insurance premiums nationwide increased 8.7% faster than inflation during 2018 and 2022.[4]

Oher initiatives like refrigerant changes drive additional costs not tied to efficiency due to the price of the refrigerant and additional safety requirements for refrigerant safety and mitigation.

The industry is aware of these price increases. Manufacturers explore technologies to reduce costs as well as improve efficiency and often absorb some of the forecasted increases through cost reduction of materials and processes.

ASHRAE appreciates DOE further investigating these other cost drivers of new construction.

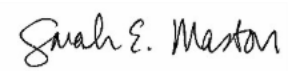
[3] April 1, 2025, Press Release from Consumer Federation of America, accessed on 07-10-2026 at https://consumerfed.org/news/press-releases/new-report-finds-american-homeowners-faced-24-increase-in-homeowners-insurance-premiums-over-the-past-three-years/

[4] U.S. Department of the Treasury, Federal Insurance Office, "Analyses of U.S. Homeowners Insurance Markets, 2018-2022: Climate-Related Risks and Other Factors," January 2025.

In closing, ANSI/ASHRAE/IES Standard 90.1 is developed through a robust, open, and rigorous process of continuous improvement. We appreciate DOE issuing this RFI so that analysis and advancement of Standard 90.1 can improve. We welcome having more accurate data, increased transparency, and more detailed analysis to better understand the impacts of Standard 90.1. At the same time, there are other opportunities to reduce the regulatory burden and simplify compliance. This could include the development of new tools and procedures. While ASHRAE and DOE are already pursuing some of these efforts independently, closer collaboration could accelerate progress.

Thank you for your consideration of our comments. If we can provide any additional information or serve as a resource, please do not hesitate to contact me or have your staff contact GovAffairs@ashrae.org.

Sincerely,



Sarah E. Maston, P.E.
ASHRAE Society President, 2026-2027

Attachment A
ASHRAE 90.1 Economic Evaluation
Scalar Ratio Procedure

1.0 Background Information

Per the ASHRAE 90.1 2025-2028 work plan cost analysis shall be considered in the evaluation of new proposals. This standard work document defines the procedure for conducting a cost analysis for the mechanical subcommittee (MSC) proposals but for Envelope, Lighting and Power and other evaluations the procedure is similar except for economic life. The procedure shall be used unless agreed to by the subcommittee and SSPC or if the change being evaluation has no impact on cost and energy.

This revision includes the changes approved by the ASHRAE 90.1 committee for the development of proposals for the 2028 standard and documented in the 2028 work plan. All proposals should include a section on the assumptions used for cost analysis and any deviations to the requirements outlined in this standard work.

The basic cost justification procedure developed by the 90.1 committee is called the Scalar Ratio (SR). To determine the Scalar Ratio for any specific proposal/addendum, you need to determine the energy savings, and other potential cost savings like operational benefits. The latter may be difficult to define, but the procedure can allow for their use, but they should be documented and be part of the committee and public review. Also, other operating cost changes like water cost, annual maintenance cost, and the incremental costs for the change should be determined and then used to compare the simple payback to the Scalar Ratio Limit defined in this standard work. The purpose of this standard work document is:

- Define the procedure for calculating the Scalar Ratio Limit (SRL) (See section 3.0)
- To define how to calculate the Scalar Ratio (SR) for specific change proposals developed by the Mechanical Subcommittee (see section 2.0)

2.0 Cost Justification Equation

For the cost justification the ASHRAE 90.1 *Scalar Ratio (SR)* as defined below shall be used to determine if a proposal is justified. To be considered a justifiable proposal the Scalar ratio must be less than the Scalar Ratio Limit as defined in section 3.0. The scalar ratio shall be calculated using the following equation.

$$SR = \frac{Delta\ First\ Price}{Delta\ Annual\ Energy\ Cost\ Savings + Delta\ Other\ Price + Delta\ Maitenance\ Price} \quad \text{equation 1}$$

Where:

SR is the Scalar Ratio for the proposal/addendum. The *scalar ratio* is essentially the simple payback for the change proposal which is a common metric of choice for the HVAC&R and building industry.

Delta First Price is the incremental Price to end user/consumer for the change. Details on determining this are included in section 5.0 of this document. We prefer to use delta price as it avoids sharing absolute prices which can cause issues with the Sherman Act and Price fixing. Using delta price for delta changes in efficiency is all that is needed. The price should include the cost of the product, burden, profit markup, distribution costs, warranty allowances, shipping, and other costs that would be in the final price to the customer/user

Delta Annual Energy Cost Savings is the delta annualized energy savings resulting from the change for one full year of operation. It includes both cooling and heating delta energy savings. Several methods can be used to determine the incremental delta cost savings, but in most cases, it should be based on an annualized basis for representative buildings in all ASHRAE 169 climate zones using the ASHRAE 90.1 reference cities. The preferred building models should be based on applicable buildings selected from the 16 benchmark reference buildings defined in the building modeling standard work document, but if needed a special building can be used if the building is not covered by the current 16 reference buildings. Modeling

Delta Other Price is the delta price for other items that might change as result of the proposal. This could include things like benefits from diagnostics and improved sustained performance as well as other similar indirect savings. These can be both positive and negative. But the assumptions and approach used to determine these prices must be included in the proposal and will be subject to committee review and public review.

Delta Maintenance Price is any incremental annual cost/price that the change proposal would add to or subtract from the yearly costs of operation. For example, the proposed change might result in increased frequency of changing filters and the cost of the filters and labor should be subtracted from the annual energy savings. Or in another proposed change the frequency of changing filters might decrease and then the cost savings per year would be added to the annual energy savings.

Other Price/Cost – Other prices and costs that may have occurred due to other industry regulatory changes or inflation should not be included in the analysis if they would have occurred for the current product or building component. For example, refrigerant change because of Kigali and EPA changes.

For proposal to be justified the *Scalar Ratio (SR)* as defined by equation 1 must be less than or equal to the *Scalar Ratio Limit* as defined in section 3.0 and as shown in equation 2.

$$SR \leq SRL \qquad \text{equation 2}$$

3.0 *Scalar Ratio Limit (SRL)*

The *Scalar Ratio Limit (SRL)* is the maximum value for a *scalar ratio* that will meet the justification criteria that has been defined by the ASHRAE 90.1 committee and as defined in the work plan. *The Scalar Ratio Limit (SRL)* is equivalent to a modified version of the net present value of the economic life energy savings benefit adjusted for inflation, discount rates, loan rates and fuel escalation. There are separate Scalar Ratio Limits for heating and cooling but in some cases, it may not be possible to separate

$$SRL = SRLH * \frac{yearly\ heating\ energy\ savings}{yearly\ total\ energy\ savings} + SRLC * \frac{yearly\ cooling\ energy\ savings}{yearly\ total\ energy\ savings} \qquad \text{equation 3}$$

Essential what this calculates is weighted average energy savings. In most cases the proposals only result in cooling savings or heating savings so one term of the equation will be zero.

The derivation of the *Scalar Ratio Limit (SRL)* procedure is defined in the paper prepared by Merle McBride titled Development of Economic Scalar Ratios for ASHRAE Standard 90.1R.

The scalar ratio limit is based on the following economic factors:

Scalar	**2010**	**2013**	**2016**	**2019**	**2022**	**2025**	**2028p**	**Delta 25-28**
Maximum Economic Life (years)	40	40	40	40	40	40	**40**	-
Loan Interest Rate (%)	7.0	6.25	7.0	5.0	5.0	4.9	**7.20**	46.9%
Discount Rate (%)	7.0	7.0	9.34	8.5	8.1	7.8	**8.71**	11.7%
General Rate of Inflation (%)	3.7	2.49	2.38	2.06	2.33	2.28	**2.54**	11.4%
Natural Gas Inflation Rate (%)*	3.7	3.67	4.58	2.73	2.90	2.27	**2.74**	20.7%
Electricity Inflation Rate (%)*	3.7	3.76	2.85	2.07	2.25	1.98	**2.24**	13.1%
Scalar for Heating (40-yr)	20.2	21.9	21.4	25.2	25.1	22.3	**17.6**	-21.1%
Scalar for Cooling (40-yr)	20.2	21.9	18.2	22.1	22.0	21.3	**16.7**	-21.6%
Energy Cost	**2010**	**2013**	**2016**	**2019**	**2022**	**2025**	**2028p**	**Delta 25-28**
Blended Heating ($/therm)	1.22	0.99	1.02	0.98	0.983	1.074	**1.2474**	16.1%
Natural Gas ($/therm)				0.8243	0.8021	0.8381	**1.0452**	24.7%
Heating Oil ($/gal)				2.6849	2.9275	2.9508	**3.4981**	18.5%
Cooling/Electricity ($/kWh)	0.0939	0.1032	0.1013	0.1063	0.1099	0.1122	**0.1316**	17.3%

The *scalar ratio limits* for 2025-2028 are shown in the following table. There are different scalar limits for heating and cooling due to the different escalation rates for natural gas and electric fuel.

Table 1 Scalar Ratio Limit

Year	2022		2025		2028	
	SR_H	SR_C	SR_H	SR_C	SRH	SRC
1	1.0	1.0	1.0	1.0	0.9	0.9
2	1.9	1.9	1.8	1.9	1.8	1.8
3	2.8	2.7	2.8	2.7	2.7	2.7
4	3.7	3.6	3.5	3.5	3.5	3.5
5	4.6	4.4	4.3	4.3	4.3	4.2
6	5.5	5.2	5.1	5.1	5.0	5.0
7	6.4	6.0	5.8	5.9	5.8	5.7
8	7.2	6.8	6.6	6.7	6.4	6.3
9	8.1	7.6	7.3	7.4	7.1	7.0
10	8.9	8.3	8.0	8.1	7.7	7.6
11	9.7	9.0	8.8	8.8	8.3	8.2
12	10.5	9.7	9.6	9.5	8.9	8.7
13	11.3	10.4	10.1	10.1	9.5	9.2
14	12.0	11.1	10.8	10.8	10.0	9.7
15	12.8	11.7	11.5	11.4	10.5	10.2
16	13.5	12.3	12.1	12.0	11.0	10.6
17	14.2	12.9	12.7	12.5	11.4	11.1
18	14.8	13.5	13.3	13.1	11.9	11.5
19	15.5	14.0	13.8	13.6	12.3	11.9
20	16.1	14.6	14.4	14.1	12.7	12.2
21	16.7	15.1	14.9	14.6	13.1	12.6
22	17.3	15.6	15.4	15.1	13.4	12.9
23	17.9	16.1	15.9	15.5	13.8	13.2
24	18.4	16.5	16.4	16.0	14.1	13.5
25	19.0	17.0	16.9	16.4	14.4	13.8

Year	2022		2025		2028	
	SR_H	SR_C	SR_H	SR_C	SR_H	SR_C
26	19.5	17.4	17.4	16.8	14.7	14.1
27	20.0	17.8	17.8	17.2	15.0	14.3
28	20.5	18.2	18.2	17.6	15.3	14.6
29	21	18.6	18.6	18.0	15.5	14.8
30	21.4	19.0	19.0	18.3	15.8	15.0
31	21.8	19.3	19.4	18.7	16.0	15.2
32	22.3	19.7	19.8	19.0	16.2	15.4
33	22.7	20.0	20.1	19.3	16.4	15.6
34	23.1	20.4	20.5	19.6	16.6	15.8
35	23.4	20.6	20.8	19.9	16.8	15.9
36	23.8	20.9	21.1	20.2	17.0	16.1
37	24.2	21.2	21.4	20.5	17.2	16.2
38	24.5	21.5	21.7	20.8	17.3	16.4
39	24.8	21.8	22.0	21.0	17.5	16.5
40	25.1	22.0	22.3	21.3	17.6	16.7
41	25.4	22.2	22.5	21.5	17.7	16.8
42	25.7	22.5	22.8	21.7	17.9	16.9
43	26.0	22.7	23.0	21.9	18.0	17.0
44	26.3	22.9	23.2	22.2	18.1	17.1
45	26.5	23.1	23.5	22.4	18.2	17.2
46	26.8	23.3	23.7	22.5	18.3	17.3
47	27.0	23.5	23.9	22.7	18.4	17.4
48	27.2	23.7	24.1	22.9	18.5	17.5
49	27.4	23.9	24.3	23.1	18.6	17.5
50	27.6	24.0	24.4	23.2	18.7	17.6

To determine which *Scalar limit* to use you need to establish the economic life for the product being analyzed.

Economic Life – This is the design life for the products. This is the only value that you need to decide that has not been defined by the ASHRAE SSPC 90.1 committee. The values shown in table 3 shall be used. The values were obtained from the ASHRAE 2015 Systems Handbook Table 4. If values are not defined for the equipment being analyzed or if there is reason for different values then provide justification for the values used as part of the proposal documentation.

Table 3– Equipment Economic Life

Equipment Type	Estimated Economic Life (yrs) [a]
Air Conditioners	
Window Unit	10
Residential single or split package	15
Commercial through the wall	15
Water Cooled Packaged	15
Duct Free Split System (single & multizone)	15
Heat Pumps	
Residential Air to Air	15
Commercial Air to Air	15
Commercial Water to Air	19
Rooftop Air Conditioners	
Single Zone	15
Multizone	15
Boilers, hot water and steam	
Steel water tube	24
Steel fire-tube	25
Cast Iron	35
Electric	15
Heating products	
Gas Fired	18
Oil Fired	18
Unit heaters (gas or electric)	13
Unit heaters (water or steam)	20
Radiant heaters (electric)	10
Radiant heaters (hot water or steam)	25
Terminals	
Diffusers, grilles, and registers	27
Induction and fan coil units	20
VAV and double-duct boxes	20

Table 3 – Equipment Economic Life (continued)

Equipment Type - continued	Estimated Service Life (yrs.) [a]
Airside	
Air washers	17
Ductwork	20
Dampers	20
Fans (centrifugal)	25
Fans (axial)	20
Fans (propeller)	15
Fans (ventilating roof mount)	20
Heat Exchangers	
DX, water and steam coils	20
Electric heaters	15
Shell and Tube heat exchangers	24
Plate frame heat exchangers	24
Heat recovery coils	15
Energy recovery heat exchangers	15
Compressors	
Reciprocating	20
Rotary	15
Scroll	15
Screw	20
Centrifugal	23
Packaged Chillers	
Air Cooled (all types)	15
Water cooled reciprocating, scroll and, rotary	15
Water Cooled Screw	20
Centrifugal	23
Absorption	23
Heat Rejection	
Cooling Towers (Galvanized metal)	20
Cooling Towers (Wood)	20
Cooling Towers (Ceramic)	34
Air cooled condensers	15
Evaporative Condensers	20
Insulation	
Molded	20
Blanket	24

Table 3 – Equipment Economic Life (continued)

Equipment Type - continued	Estimated Service Life (yrs.) [a]
Insulation	
Molded	20
Blanket	24
Pumps	
Base-mounted	20
Pipe-mounted	10
Sump and well	10
Condensate	15
Drives	
Reciprocating Engines	20
Gas Turbines	30
Steam Turbines	30
Electric Motors	18
Motor Starters	17
Transformers	
Low and High Voltage	30
Controls	
Pneumatic	20
Electric	16
Electronic	15
Actuators	
Hydraulic	15
Pneumatic	20
Electric	10

a. Further information on estimated design life can be found in the ASHRAE Systems Handbook Section 36.3

4.0 Energy and Operating Costs

To determine the energy savings, we need to know the cost of heat fuels and electricity costs. The SSPC has defined the US blended numbers that shall be used.

4.1. Energy Cost – This value has been defined by the ASHRAE 90.1 committee and represents the blended rate for electric, gas and oil. You would only use this if you were doing an analysis where the method for cooling and heating is not known, which likely will not be the case for mechanical evaluations.

US Blended Fuel Price = 1.2474 $/therm (12.474 $/MBtu)

4.2 Heating Cost

If you know the heating fuel for the analysis is 100% gas or 100% oil then you can use the following values which are US average prices.

US Average Gas Price = 1.0452 $/therm (104.52 $/MBtu)

US Average Oil Price = 3.4981 $/therm (349.81 $/MBtu)

Note there are several terms used for gas energy

- MBtu is 1,000 Btu
- k/Btu is 1,000 Btu (not typically used)
- Therm is 100,000 Btu
- MMBtu is 1,000,000 Btu

4.3. Electric Price – This value has been defined by the ASHRAE 90.1 committee.

US Average Electric Price = 0.1316 $/kWh.

4.4 Time of Use Energy

ASHRAE 90.1 has also established time of use pricing which can be used in place of the average pricing for proposals that are sensitive to time of use like thermal and energy storage. The values are shown below. A separate standard work document is being developed to explain how to use the time of use factors.

Season	Winter	Summer
Applicable Months	Jan. – May Oct. – Dec.	June – Sept.
per kWh during On-Peak hours	$0.0640	$0.0940
per kWh during Off-Peak hours	$0.0510	$0.0510
Monthly Demand Charge	$10.12 / highest kW on-peak $5.77 / highest kW all-hours	$14.40 / highest kW on-peak $6.81 /highest kW all-hours
On-Peak Period:	M-F Energy: 6 am – 10 am and 4 pm – 9 pm Demand: 4 pm – 9 pm	M-F Energy and Demand: 12 pm – 9 pm
Off-Peak Period:	All other hours	All other hours

4.3 Other Operating Costs

There may be other operating costs that occur on an annual basis that you should include in the annual operating cost. The Chiller water plant working group has done a survey of the old 2013 17 benchmark cities and established values for supply water and wastewater. They are shown in the following table. We are in the process of updating this table to support some anticipated work on chiller efficiencies.

Climate Zone	Benchmark City	Water Cost	Sewage Cost
		$/1000 gal	$/1000 gal
1A	Miami	1.63	1.34
2A	Houston	3.88	5.49
4C	Salem	2.59	2.75
1B	Riyadh	6.68	10.03
2B	Phoenix	4.46	2.51
3B	El Paso	4.68	1.70
3A	Memphis	1.63	1.34
3C	San Francisco	7.22	8.86
4A	Baltimore	2.50	6.61
5A	Chicago	2.89	2.66
5C	Vancouver	4.96	3.16
6A	Burlington	4.68	3.16
4B	Albuquerque	1.85	7.27
5B	Boise	1.85	1.10
6B	Helena	3.62	3.37
7	Duluth	2.98	10.31
8	Fairbanks	8.60	10.39
Average		3.92	4.83

4.4 Maintenance Cost

If there is deference in the complexity of the new proposal vs the base case then incremental maintenance cost should be added or subtracted from the annual energy cost. In many cases this may be zero and then can be ignored, but if there is a difference then include the cost. Refer to section 6.0 regarding how to get maintenance costs and requirements for confidentiality

5.0 Product Prices

The product costs are the initial costs for the product. Typically, they will be delta price vs the base case price. They should be costs including the product cost, profit, shipping costs and any delta costs for installation, commissioning and startup. Where possible use industry data from references like RSMeans. Another option is to do blind surveys of manufacturers and then use an industry organization to combine the results and remove any references to manufactures. Data can be presented as an average but in some cases the delta range may also be shared.

6.0 Determining Costs for Products, Maintenance and other Incremental Cost

Per ASHRAE procedures we are required to share the analysis done to justify a change proposal, but extreme care must be used in disclosing costs to avoid legal issues with US government laws like the Robinson-Patman Act, which prohibits certain discriminatory pricing activities and the Sherman Anti-Trust Act which governs requirements on pricing fixing. If there are any questions or uncertainty check with ASHRAE legal staff.

In general cost should be based on **the final cost for the end customer** for the products and should include all delivery, installation, startup and warranty costs.

Do not use confidential costs or costs from a single manufacturer. The following are some recommended suggestions on ways to obtain costs.

- Use publicly available cost estimating documents and tools like RS Mean – Mechanical Cost Data. The latest version is the 2017 version. Information can be obtained from the following website http://www.constructionbook.com.

- Use cost information that has already been published in an ASHRAE or other publicly available paper or publication. Do not use cost information from documents that are marked as confidential unless approval to use is in writing from the author.
- Use delta costs instead of absolute costs such that you are not publishing absolute industry costs. Try to obtain the delta costs as average industry delta costs derived from organizations that can develop average costs without sharing the information between manufacturers.
- As a last resort use industry average absolute costs but again try to get them through impartial industry organizations that can develop the average costs without sharing the costs between manufacturers.

Again, if there are any doubts or questions about the legal ramifications of sharing the costs consult ASHRAE or appropriate legal counsel.