AN HVAC TOTAL SYSTEM PERFORMANCE RATIO REQUIREMENT IN WASHINGTON CODE WILL ENSURE EFFICIENT SYSTEMS AND ACCURATE EFFICIENCY MEASUREMENT

As proposed by the Northwest Energy Efficiency Alliance (NEEA) and developed by Pacific Northwest National Laboratory (PNNL), an HVAC Total System Performance Ratio (TSPR) requirement in the 2018 Washington State Energy Code would require building designers to use more efficient HVAC systems that are evaluated based on whole-system performance.

PROBLEMS WITH CURRENT HVAC ENERGY CODE

Today's Washington State Energy Code perpetuates the use of less efficient HVAC systems by treating high- and low-performing HVAC systems equally. This is because a) current code only evaluates the efficiency of equipment within the same category (e.g., electric furnaces are only evaluated against electric furnaces as opposed to alternate and potentially more efficient heating options); and b) current code separately evaluates each individual equipment type within the HVAC system (e.g., chiller, boiler, heat pump, fan and cooling towers), instead of evaluating the HVAC system performance holistically.

While other high-impact systems, such as lighting, are already governed by code requirements that address these nuances, current HVAC code requirements impose minimal market pressure for building designers to consider the overall efficiency of the system.

PROPOSED SOLUTION: AN HVAC TOTAL SYSTEM PERFORMANCE RATIO

Based on HVAC systems proven to perform well in four specific building types (office, education, retail and library), a Total System Performance Ratio compares the annual heating and cooling energy provided to the building to that of the annual carbon emissions of energy consumed by the building's HVAC system.*

$$\frac{\text{annual heating and cooling energy provided to the building}}{\text{annual carbon emissions of energy consumed by the building's HVAC system}} = \text{Total System Performance Ratio}$$

The higher the Total System Performance Ratio, the higher the efficiency of the HVAC system. To meet a state code requirement that incorporates this ratio, mechanical engineers must avoid inefficient system types and configurations that are currently code-compliant.

Under this proposed solution, the code documentation will include an approach for engineers to calculate the performance ratio using hourly building energy simulation. Alternately, engineers will have the option to input the characteristics of the building and its mechanical systems into a software tool, currently under development by PNNL, as a module of the US Department of Energy's Asset Rating Tool. The tool will set a minimum allowable Total System Performance Ratio target for each building type based on its characteristics.

BENEFITS

- Restricts the use of inefficient HVAC systems, leading to reduced energy use
- Educates engineers on HVAC system energy use and cost-effective systems that save energy
- Does not require complex energy modeling
- Reduces operating costs once building is finished and occupied

*Carbon emissions by fuel type are provided by Washington State Department of Commerce and included in the proposal.

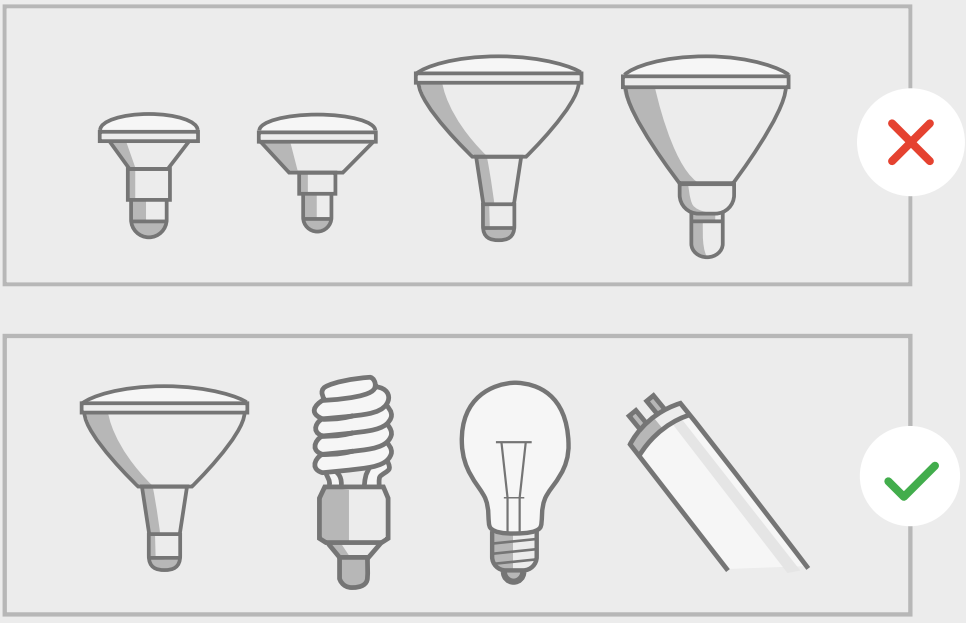
THE TOTAL SYSTEM PERFORMANCE RATIO HELPS WASHINGTON ACHIEVE ITS AMBITIOUS ENERGY-SAVING GOALS

By not accounting for full-system HVAC efficiency, current Washington code disincentivizes energy-efficient HVAC system types and designs. Requiring the Total System Performance Ratio would level the playing field for efficient technologies, promote more efficient design approaches and help buildings save more energy.

As Washington State works to achieve a 70-percent reduction in new building energy use by 2031, performance-based energy codes will likely become increasingly more necessary and prevalent. An HVAC Total System Performance Ratio requirement would help familiarize the HVAC industry with this approach and, when combined with whole-building lighting and envelope standards, could help establish a performance path to help Washington achieve its long-term goals.

THE IMPORTANCE OF CROSS-CATEGORY BASELINES

Although a water-source heat pump has a much higher coefficient of performance (COP) than an electric furnace—meaning it uses less energy and costs less to operate—current Washington code compares the electric furnace's energy performance to other electric furnaces and not to other, more efficient, heating alternatives. Therefore, both the electric furnace and the water-source heat pump meet code even though the water-source heat pump is by far the more efficient heating option.



Current Washington code does not compare electric furnaces across category types. If this code approach was applied to lighting, we would have one standard for fluorescent, one standard for LED, and another for incandescent bulbs, without ever comparing the efficiency of the bulbs across type.