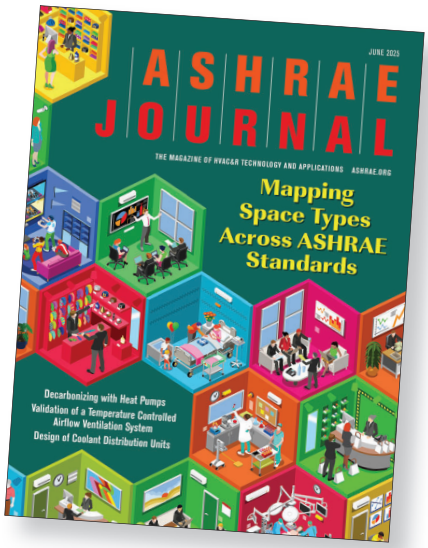
Decarbonizing with Heat Pumps

The June 2025 *ASHRAE Journal* article "Decarbonizing with Heat Pumps—Most Do, Some Don't" by Steve Kavanaugh is an in-depth study, comparing the operational energy and carbon dioxide (CO_2) emissions of air-and ground-source heat pumps and natural gas furnace/AC systems for selected locations in cold climates. It has demonstrated the dependency of the effectiveness of heat pumps for CO_2 reduction on the electricity generation emissions and the actual system performance. The main purpose of the comments below is to draw attention to other considerations for more comprehensive assessments.



In reference to Figure 3, the statement that, despite the added wind/solar facilities, "improvements in grids of states with aggressive heat pump programs have encountered a stagnation or even a slight increase of CO_2 generation per energy output" requires more in-depth examination for the following reasons:

1. The CO_2 emissions data of the figure is for the grid electricity generation and does not seem to reflect the abated carbon resulting from the replacement of the fossil fuel furnaces with heat pumps.
2. The added wind and solar capacities are the aggregate quantities and not specifically applicable to any of the cold-climate states.
3. In contrast to natural gas power plants, the actual outputs of the added renewable energy facilities are expected to represent smaller fractions of their respective capacities—considering their source energy intermittencies, perhaps inadequate battery storage capacities (or lack thereof), interconnection status, etc.
4. The yearly variations of the electrical energy consumption and demand profiles, which are not presented, can influence the effective primary energy mix (e.g., coal, gas and renewables) for electricity generation. The winter season severity, for example, can reduce the contribution of renewables. Potential impacts of events such as COVID-19 may also warrant a more detailed examination. The performance comparisons of the heat pumps and gas-fired furnaces have solely focused on the operational energy and the ensuing CO_2 emissions. However, the respective embodied quantities can have a significant impact on the results and conclusions. Similarly, life-cycle cost assessments would take precedence over estimates of the operational energy cost alone.

Ali Jalalzadeh-Azar, Ph.D.
Member ASHRAE
Matthews, N.C.

KAVANAUGH RESPONDS

You are correct in that more detailed analysis is warranted. The information of the type presented in the article is an important component in the larger analysis. The uncertainties of many of the items you suggest would be very high even if the pre-2025 emphasis on addressing climate change continued. The growth in data center energy use may likely in the near term be provided by high heat rate combustion turbine generators and repurposed coal-fired plants. This compounds these uncertainties of the analysis you suggest. A concern is also raised about if the necessary information sources such as the Energy Information Administration will remain viable.

At some point in the future a more balanced approach to energy generation and consumption may evolve based on the costs of fuel, generation facilities, grid expansions and batteries. Currently, there is also an absence of field-measured end-use equipment performance. Lower uncertainties in the data required for the analyses you suggest would make them more accurate and useful.

Steve Kavanaugh, Ph.D
Fellow/Life Member ASHRAE
Kyle, Texas