High SEER Hype

Steve Kavanaugh, Professor of Mechanical Engineering, The University of Alabama

Please be advised the heat pump and air-conditioner SEER (seasonal energy efficiency ratio) rating can be a misleading indicator for hot-humid and very hot-dry climates. A technical paper outlining the reasons for this position was published by the American Society of Heating, Refrigerating and Air-conditioning Engineers ("Limitation of SEER for Measuring Efficiency", *ASHRAE Journal*, July 2002)[1]. The primary points made in the article include the following.

- SEER is a measure of cooling efficiency when the indoor temperature is 80ºF and the outdoor temperature is 82ºF for constant speed air-conditioners and heat pumps. Note: The indoor relative humidity for the rating is 50% (67ºF wet bulb temperature[2]).
- For 2-speed (or variable speed) heat pumps, SEER is a measure of efficiency when the indoor temperature is 80ºF averaged over a variety of outdoor air temperatures. The outdoor temperatures used in the calculation are actually lower (between 67ºF and 77ºF) than the indoor temperature for two-thirds of values used to compute SEER. Only 4 of the 1000 outdoor temperature values used are above 97ºF.
- Higher SEER ratings can be obtained by operating in a mode in which moisture removal is poor or non-existent but the SEER rating procedure places no restrictions on a unit's inability to remove moisture. Units operating with poor moisture removal capacity elevate the risk of moisture and mold related problems.
- The "Limitation of SEER for Measuring Efficiency" article examines a manufacturer's data to compare the performance of a 10 SEER unit with an 18 SEER unit. At 95ºF outdoor temperature and 80ºF indoor temperature, the efficiency of the 18 SEER unit is only 6% higher than the 10 SEER unit. However, the 10 SEER unit has a 22% higher moisture removal capacity than the 18 SEER unit. Reduced moisture removal capacity is not advised in hot-humid climates.
- The heating efficiency HSPF (Heating Seasonal Performance Factor) of the 10 SEER heat pump was 1% higher than the heating efficiency of the 18 SEER unit.
- Some sales personnel will suggest the main reason for reduced energy bills is the high efficiency of the 2-speed heat pumps during periods when the cooling requirement is low. This high efficiency during low-loads is typically obtained when the indoor fan is running at higher speeds. When this occurs the indoor coil will not be able to maintain a temperature that is cold enough to remove moisture effectively. At low-load conditions, moisture removal is especially critical in humid or semi-humid climates. Two-speed units do have the flexibility to lower fan speed so that moisture can be removed BUT they will not operate at high efficiency when this is done. Therefore, high low-load efficiency comes at the expense of moisture removal during periods when it is most needed.
- The actual reduction in energy consumption realized by high SEER heat pumps or air conditioners compared to minimum SEER units is likely to be insignificant.

It is therefore suggested that:

- Customers should request certified performance data (Total cooling capacity, sensible cooling capacity and EER) for the base equipment (SEER ≈ 13) and the higher SEER options for 95ºF outdoor air temperature and 75ºF indoor temperature and 50% relative humidity (63ºF indoor wet bulb temperature).
- Cooling equipment with a sensible heat ratio (SHR = sensible cooling capacity ÷ total cooling capacity)[3] greater than 0.75 with an indoor air temperature of 75ºF and 50% relative humidity (63ºF wet bulb) should be avoided in hot-humid climates.
- For heat pumps, customers should request performance data (Heating capacity and COP[3]) with 17ºF outdoor air temperature and 70ºF indoor air temperature.
- Until the rating method is modified to more closely represent operating conditions in hot and hot-humid climates, the cooling EER and heating COP values are suggested as better indicators for estimating relative cooling and heating costs rather than SEER or the similar heating mode indicator HSPF.

[1] The complete article "Limitation of SEER for Measuring Efficiency" is available from www.ashrae.org.
[2] Wet bulb temperature is determined by covering a thermometer bulb with a wet wick and blowing air across it or "slinging" the bulb though the air.
[3] Sensible cooling capacity is an indicator of a unit's ability to lower air temperature. Total cooling capacity is an indicator of ability to lower air temperature and lower humidity. Thus, a high SHR indicates low moisture removal capability.
[4] The COP (Coefficient of Performance) is the amount of heat provided by the heat pump divided by the power input requirement.