Proposed Expansion of ENERGY STAR® Room Air Conditioner Criteria to Include Reverse Cycle (Heat Pump) Room Air Conditioners

Summary

This document proposes the expansion of the ENERGY STAR Room Air Conditioner (RAC) criteria to include all reverse cycle room air conditioners. The analysis below presents background information, market conditions, proposed criteria and potential energy savings of expanding the ENERGY STAR RAC program.

The existing ENERGY STAR RAC criteria—a minimum Energy Efficiency Ratio (EER) 10 percent more efficient than the Federal standard—would be extended to cover the cooling performance of reverse cycle products. The heating performance would not be covered in the criteria. Only reverse cycle products would be eligible.

The revised criteria would also include language indicating electric resistance heat room air conditioners are not eligible for ENERGY STAR qualification.

Background and Rationale

The current ENERGY STAR Room Air Conditioner (RAC) criteria require products to be a minimum of 10 percent more energy efficient than minimum Federal Government standards. The existing eligible products are cooling-only RACs without reverse cycle. These consist of window RACs, through-the-wall RACs, and the casement and slider-casement RAC products. No RAC products that produce heat, such as reverse cycle RACs or electric resistance heat RACs, are currently eligible for ENERGY STAR qualification.

Reverse-cycle RACs are typically referred to as heat pump RACs. These products have a reverse cycle that allows them to function as a heat pump and provide space heating in addition to space cooling within the confines of an appropriately sized room. Heat pump models are covered under the U.S. Department of Energy (DOE) RAC product classes for standards setting purposes.

Market Factors

Market Size

The market for heat pump RACs is relatively small in the United States. Estimates indicate heat pump RAC shipments account for around 1 percent of total annual RAC shipments, which are roughly 82,160 models per year[1].

[1] Annual heat pump RAC shipment estimate is based on anecdotal information and data from appliance manufacturers. Interested stakeholders are encouraged to provide any additional non-confidential information to support this analysis. Any new information will be used in a subsequent analysis.

Product Considerations
Most heat pump RACs have back-up electric resistance heaters. Back-up electric resistance heaters are inefficient by their nature. However, on most heat pump RACs, the product operates in the heat pump mode until the outdoor temperature drops below a certain level (e.g., 40 degrees), at which point the electric resistance heater begins operation.

Although heat pump RACs contain electric strip heaters, it is not the primary heat source. Furthermore, the heat pump RAC is still more efficient than a unit with only electric resistance heat.

There are a few heat pump RAC products on the market that have no electric resistance heater. These models are regional; typically shipped to Southern states such as Florida, Mississippi and Texas where heating loads are much lower than the national average. These make up a small percentage of the RAC heat pump market and would also be included in the proposed criteria.

Proposed ENERGY STAR Criteria Performance Levels

The Department proposes to expand the criteria to include all heat pump RACs, even the heat pump products that have a back-up electric resistance heat function. In addition to the minimum EER requirement, the ENERGY STAR criteria for heat pump RACs would include language that excludes electric resistance heat RAC products that are not heat pump models.

The proposed new criteria language and EER levels (see Table 1) is as follows:
ENERGY STAR qualified RACs must have an EER 10 percent more efficient than the minimum Federal standard. All cooling-only RACs that fall under the DOE product classes are eligible (DOE Product Classes 1-10 and 15-16). All reverse cycle RAC models (DOE Product classes 11-14) are also eligible. Models with exclusively electric resistance heat are not eligible.

Note: The minimum Federal EER requirements of the heat pump models are typically lower due to the reversing valve. Reversing valves add additional load to the system and increase a unit's power requirement by an estimated 5 percent.

Table 1: Proposed ENERGY STAR Criteria for Room Air Conditioners with Reverse Cycle

DOE Product Class	Federal Minimum EER	Proposed ENERGY STAR EER
With reverse cycle, with louvered sides, and less than 20,000 BTU/hour	9	9.9
With reverse cycle, without louvered sides, and less than 14,000 BTU/hour	8.5	9.4
With reverse cycle, with louvered sides, and 20,000 BTU/hour or more	8.5	9.4
With reverse cycle, without louvered sides, and 14,000 BTU/hour or more	8	8.8

Potential Energy Savings

The potential national energy savings will not be as significant as some of the other ENERGY STAR qualified RAC categories given the low number of annual heat pump RAC shipments. However, establishing ENERGY STAR criteria for heat pump RACs will encourage manufacturers to pursue better efficiencies on their heat pump models. The proposed criteria will also create potential savings for consumers who purchase energy efficient heat pump RACs instead of electric resistance heat RACs.

Table 2 shows the estimated annual energy consumption for both heat pump RACs and electric resistance heat RACs in select cities[2]. In each city, appropriate weather data[3] was used to determine consumption in cooling and heating modes. The weather data was used to estimate heating operation in the heat pump and electric resistance modes.

Table 2: Estimated RAC Unit Annual Energy Consumption (kWh/year) by City[4]

City	RAC Product Type	Annual Energy Consumption (kWh/year)
Kansas City, MO	ENERGY STAR qualified heat pump[5]	5,048
	Non-qualified heat pump[6]	5,213
	Non-qualified electric resistance heat[7]	6,332
Atlanta, GA	ENERGY STAR qualified heat pump	3,961
	Non-qualified heat pump	4,196
	Non-qualified electric resistance heat	5,639
Tampa, FL	ENERGY STAR qualified heat pump	3,519
	Non-qualified heat pump	3,850
	Non-qualified electric resistance heat	4,585
Dallas, TX	ENERGY STAR qualified heat pump	3,577
	Non-qualified heat pump	3,804
	Non-qualified electric resistance heat	4,909

[2] Based on anecdotal information from manufacturers, four cities were selected based on heat pump RAC shipments.
[3] Heating and cooling load hours are estimated using a methodology from the Air-Conditioning Contractor's of America (ACCA) Manual J. Weather data from National Oceanic and Atmospheric Administration (NOAA) and design temperatures from American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) were used to estimate heating and cooling load hours. Weather bin data from ACCA was used to weight heating load hours in either heat pump or electric resistance mode, based on outdoor conditions and operational characteristics of heat pump RACs.
[4] Heat pump RACs do not operate continuously, but cycle around a thermostatic set point. Consumption and savings are estimated using a methodology similar to central air-source heat pump systems. The cooling and heating efficiencies of the heat pump RAC were transferred to efficiency units of central air-source heat pump systems. From the National Energy Audit Tool for a RAC operating intermittently on thermostat: SEER = 1.2 X EER – 0.7 and HSPF = 2.4 X COP or (2.44 / 3.412) X EER.
[5] Heat pump RAC, with electric resistance back-up that exceed Federal standards by 10 percent.
[6] Heat pump RAC, with electric resistance back-up that just meets current Federal efficiency standards.
[7] Electric resistance heat-only RAC that meets current Federal efficiency standards.

Based on the consumption averages in Table 3, the following charts illustrate two savings scenarios:

1. Table 3: ENERGY STAR qualified heat pump RAC compared to a non-qualified heat pump RAC.
2. Table 4: ENERGY STAR qualified heat pump RAC compared to an electric resistance heat RAC.

Table 3: ENERGY STAR Qualified Heat Pump RAC Unit Savings (Compared to a Non-Qualified Heat Pump RAC) by City		
City	**Energy Savings (kWh/year)**	**Dollar Savings**
Kansas City, MO	165	$14
Atlanta, GA	235	$20
Tampa, FL	331	$28
Dallas, TX	227	$19
$.086/kWh used to estimate dollar savings[8].		

Table 4: ENERGY STAR Qualified Heat Pump RAC Unit Savings (Compared to a Non-Qualified Electric Resistance Heat RAC) by City		
City	**Energy Savings (kWh/year)**	**Dollar Savings**
Kansas City, MO	1,284	$110
Atlanta, GA	1,678	$144
Tampa, FL	1,066	$92
Dallas, TX	1,332	$115
$.086/kWh used to estimate dollar savings.		

Table 5 estimates the potential national energy savings of an ENERGY STAR qualified heat pump RAC program. For the purpose of this analysis, national energy savings numbers are listed below. The numbers were calculated by equally weighting savings numbers of the cities chosen in this analysis.

Table 5: National Energy Savings (heating and cooling)			
Savings Comparison	**ENERGY STAR Shipments**[9]	**Unit Savings (kWh/year)**	**National Aggregate Savings (MWh/year)**
ENERGY STAR Qualified Heat Pump vs. Non-Qualified Heat Pump	23,695	239	5,672
ENERGY STAR Qualified Heat Pump vs. Non-Qualified Electric Resistance Heat	23,695	1,340	31,751
Assuming Heat Pump RACs are 1 percent of annual RAC shipments and ENERGY STAR market penetration is 29 percent.			

[8] National average electricity costs as published by the US Department of Energy in the Federal Register on January 27, 2004.

[9] ENERGY STAR RAC market penetration is from D&R International's 2003 sales data report. The sales data represents total RAC sales and includes sales from participating national retail ENERGY STAR partners.

Conclusion

The Department recommends incorporating ENERGY STAR criteria for heat pump RACs into the existing RAC criteria. The expansion will effectively put an incentive in place for the heat pump RAC category; a room air conditioner configuration that is currently not covered by ENERGY STAR. This action will help generate additional energy savings in specific regions of the country with high use of RACs with cooling and heating. Also, large additional savings will be generated for consumers that purchase a heat pump RAC unit instead of an electric resistance heat RAC.

The proposed effective date for this expansion is **October 1, 2005**.