Energy Efficiency and Renewable Energy
Federal Energy Management Program

How to Buy an Energy-Efficient Commercial Heat Pump

Why Agencies Should Buy Efficient Products

- *Executive Order 13123 and FAR part 23 direct agencies to purchase products in the upper 25% of energy efficiency, including all models that qualify for the EPA/DOE* ENERGY STAR® *product labeling program.*
- *Agencies that use these guidelines to buy efficient products can realize substantial operating cost savings and help prevent pollution.*
- *As the world's largest consumer, the federal government can help "pull" the entire U.S. market towards greater energy efficiency, while saving taxpayer dollars.*

For More Information:

- DOE's Federal Energy Management Program (FEMP) Help Desk and World Wide Web site have up-to-date information on energy-efficient federal procurement, including the latest versions of these recommendations.
  Phone: (800) 363-3732
  www.eren.doe.gov/femp/procurement
- Environmental Protection Agency maintains a listing of ENERGY STAR® commercial heat pumps.
  Phone: (888) 782-7937
  www.energystar.gov/products
- Consortium for Energy Efficiency (CEE) has utility programs promoting energy-efficient commercial heat pumps that meet this recommendation.
  Phone: (617) 589-3949
  www.cee1.org
- American Council for an Energy-Efficient Economy (ACEEE) publishes the *Guide to Energy-Efficient Commercial Equipment* that lists models meeting this Recommendation.
  Phone: (202) 429-0063
  aceee.org
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) publishes the *Cooling and Heating Load Calculation Manual*.
  Phone: (800) 527-4723
  www.ashrae.org.
- Lawrence Berkeley National Laboratory provided supporting analysis for this recommendation.
  Phone: (202) 646-7950

Efficiency Recommendation

Product Type and Size	Recommended[a]	Best Available[b]
Air Source[c] < 65 MBtu/h	12.0 SEER or more 7.7 HSPF or more	13.2 SEER 8.5 HSPF
Air-Source 65 – 135 MBtu/h	10.1 EER or more 10.4 IPLV or more 3.2 COP or more	11.5 EER 13.4 IPLV 4.0 COP
Air-Source 135 – 240 MBtu/h	9.3 EER or more 9.5 IPLV or more 3.1 COP or more	10.5 EER 12.4 IPLV 3.3 COP
Water-Source[d] 65 – 135 MBtu/h	12.8 EER or more 4.5 COP or more	14.5 EER 5.0 COP

a) Efficiency levels for air-source units sized between 65 and 240 MBtu/h meet ASHRAE 90.1 minimum efficiency requirements.

b) The best available EER and best available COP apply to different models.

c) Only units with 3-phase power supply are covered in this category.

d) Water source heat pumps covered here use cooling towers and boilers as the heat transfer sink or source in a closed loop piping system. This may increase boiler energy use by lowering the return water temperature. Auxiliary pumping energy is not included in the WSHP efficiency rating.

Definitions

EER, or Energy Efficiency Ratio, is the cooling capacity (in Btu/hour) of the unit divided by its electrical input (in watts) at standard peak rating conditions. SEER (Seasonal Energy Efficiency Ratio) and IPLV (Integrated Part-Load Value) are similar to EER, but weigh performance during the cooling season.

COP (Coefficient of Performance) is the heating capacity (in Btu/h) at standard heating conditions divided by its electrical input (also in Btu/h). HSPF (Heating Seasonal Performance Factor), like SEER, weighs heating performance at various conditions.

Money Isn't All You're Saving

How to Select an Energy-Efficient Heat Pump

When selecting a commercial heat pump, specify or select an ENERGY STAR® labeled model or one that meets or exceeds these recommended levels. All ENERGY STAR commercial heat pumps meet the levels listed in this recommendation. The ENERGY STAR web page lists complying models (see "For More Information").

When to Choose a Heat Pump

Air source heat pumps operate inefficiently at sub-freezing temperatures, so avoid them as stand-alone heating systems in cold climates. However, in mild climates, they generally offer savings comparable to those units with electric resistance heating coupled with a unitary air conditioner. Depending on both climate and

utility costs, heat pumps may be cost-effective when compared to gas or oil furnaces.

Sizing

Oversizing of heat pumps, besides raising purchase cost, will increase energy use, reduce humidity removal, and shorten product life, all due to excessive on-off cycling ("short-cycling"). The required heat pump capacity should be determined based on the referenced ASHRAE calculation procedure (see "For More Information").

Technology Options

In large applications with multiple units, water-source models may be cost-effective, but cooling tower energy (pumps and fans) must be considered in the economic analysis. Economizers use controllable dampers to provide "free" cooling by letting outside air cool the space when the outdoor temperature or enthalpy are below the building's return air values. When properly controlled and maintained, economizers can decrease cooling energy usage substantially. If there is adequate land space, ground source heat pumps can be more cost effective than air or water source heat pumps because of the lower energy and maintenance costs (see "How to Buy an Energy-Efficient Ground-Source Heat Pump").

Installation and Maintenance

Proper installation and maintenance of commercial heat pumps are essential for effective and efficient operation. ACEEE's "Guide to Energy-Efficient Commercial Equipment" along with other publications from CEE that provide tips on installation and maintenance concerns (see "For More Information"). Duct losses are a major source of energy waste and comfort problems with heat pumps; make sure ducts are well sealed. Choosing and setting controls properly is also important to preventing energy losses; careful attention should be paid to minimizing operation of electric resistance heating.

Environmental Tips

Many of today's commercial heat pumps use HCFC refrigerants and other refrigerants with a low Ozone Depletion Factor (ODF). When retiring an air conditioner that contains CFCs or HCFCs, the Clean Air Act requires that the refrigerant be recovered on-site by a certified technician. For information, contact EPA's hotline at (800) 296-1996.

Heat Pump Cost-Effectiveness Example
(Air-Source – 120 MBtu/hour – 10 tons)

Performance	Base Model[a]	Recommended[b]	Best Available
EER / IPLV / COP	8.9 / 9.2 / 3.0	10.1 / 10.4 / 3.2	11.5 / 13.4 / 4.0
Annual Energy Use	37,100 kWh	33,800 kWh	26,600 kWh
Annual Energy Cost	$2,200	$2,000	$1,600
Lifetime Energy Cost	$22,200	$20,200	$15,900
Lifetime Energy Cost Savings	–	**$2,000**	**$6,300**

a) The integrated part-load value (IPLV) corresponds to an average model meeting the minimum national standard EER of 8.9.

b) For illustration only, there may not be an actual model available that just meets all 3 efficiency criteria.

Using the Cost-Effectiveness Table

In the example shown above, an air-source heat pump with an EER of 10.1, an IPLV of 10.4, and a COP of 3.2 is cost-effective if its purchase price is no more than $2,000 above the price of the Base Model. The Best Available model, with an EER of 11.5, an IPLV of 13.4, and a COP of 4.0, is cost-effective if its price is no more than $6,300 above the price of the Base Model.

What if my Electricity Price, Capacity, or Load Hours are different?

FEMP provides a Web-based "cost calculator" screening tool that simplifies energy cost comparisons between different commercial heat pumps. The cost calculator allows you to adjust the capacity, hours of operation, and electricity cost for your installation. To use the calculator, go to www.eren.doe.gov/femp/procurement/calc_heatpumps.shtml.

Assumptions

The cost effectiveness example assumes annual energy use is based on the standard DOE test procedure for a model with 1,500 equivalent full-load heating and cooling hours per year. The assumed electricity price is 6¢/kWh (including demand charges).

Definition

Lifetime Energy Cost is the sum of the discounted (present) value of annual energy costs based on average usage and an assumed heat pump life of 15 years. Future electricity price trends and a discount rate of 3.3% are based on federal guidelines (effective from April, 2001 to March, 2002).

Metric Conversions

1 MBtu/h = 1,000 Btu/h
= 293 Watts
*°F = (1.8 * °C) + 32*

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