

# Achieving ENERGY EFFICIENCY with Standard Air-Conditioning Units



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**AdvanTek**

# Standard Air Conditioning Unit

Packaged Unit  
Split System  
DX (not chilled water)  
Air-cooled



# ENERGY EFFICIENCY

## ◆ EER

- single point *Energy Efficiency Ratio*
- MBH per kW

## ◆ SEER (5 tons and less)

- *Seasonal Energy Efficiency Ratio*
- kBtu per kWh

## ◆ IPLV (10 tons and up)

- Seasonal *Integrated Part-Load Value*
- MBH per kW

# FEMP Recommendation\*

<b>Efficiency Recommendation</b>		
<b>Product Type<sup>a</sup> and Size</b>	<b>Recommended</b>	<b>Best Available</b>
<b>&lt; 65 MBtu/h (3 phase)</b>	<b>12.0 SEER or more<sup>b</sup></b>	<b>14.5 SEER</b>
<b>65 – 135 MBtu/h</b>	<b>11.0 EER or more 11.4 IPLV or more</b>	<b>11.8 EER 13.0 IPLV</b>
<b>&gt; 135 – 240 MBtu/h</b>	<b>10.8 EER or more 11.2 IPLV or more</b>	<b>11.5 EER 13.3 IPLV</b>

***\*How to Buy an Energy-Efficient Commercial Unitary Air Conditioner***

NOVEMBER 2001

# CEE Recommendation

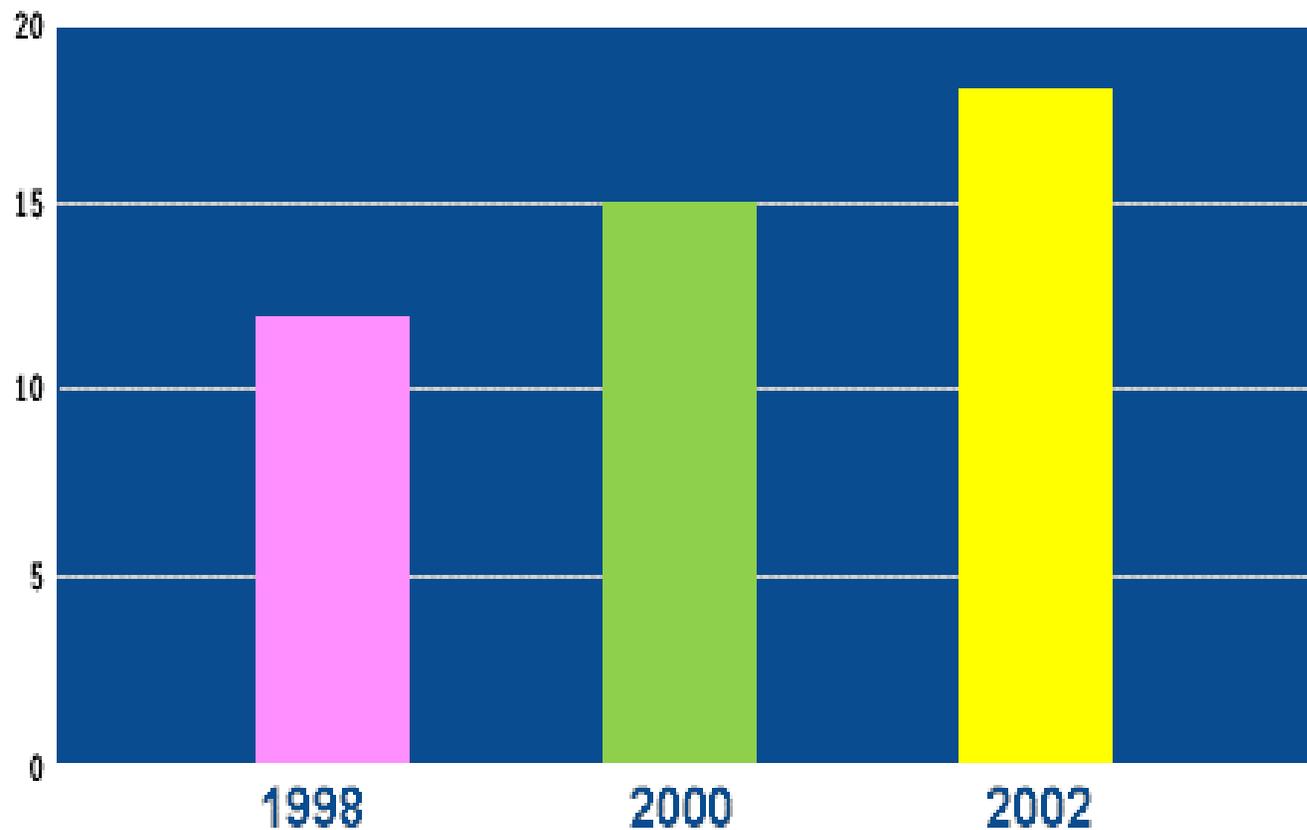
CEE's Tier I level is minimum industry standard. CEE's Tier II is the new "high efficiency" requirement, promoted by ENERGY STAR<sup>®</sup> and FEMP.

## Minimum Allowable EER Ratings MBH per kW

	MBH 65-135	135-240
ASHRAE 90.1-1999 (Effective 10/29/2001)	10.3	9.7
CEE - Tier I	10.3	9.7
CEE - Tier II and EPA Energy Star	11.0	10.8
FEMP (as of 1/1/2002)	11.0	10.8
FEMP (after 1/3/2006)	<b>12.0</b>	<b>12.0</b>

*MBH = kBtu/hr (1 ton = 12 MBH)  
(65 = 5.4 tons, 135 = 11.3 tons, 240 = 20 tons)  
CEE - Consortium for Energy Efficiency  
EER - Energy Efficiency Rating  
FEMP – Federal Energy Management Program*

# Percent Meeting CEE Tier II\*



\*<http://www.cee1.org/resrc/updates/02-08hecac/02-08hecac.html>

# What is available *today*?

◆ “Standard Efficiency” IPLV **8.5 to 10.0**

◆ “High Efficiency” IPLV **9.5 to 14.0**

- So-called “High Efficiency” unitary products are 10% to 40% more energy efficient than “Standard Efficiency.”

**Systems 5-tons and smaller are as high as SEER 18**

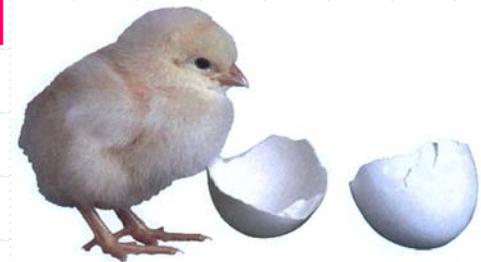
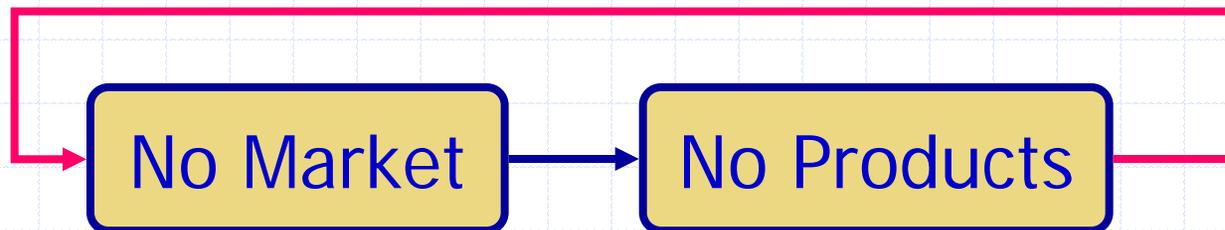
**Water cooled-chiller systems are as high as IPLV 20**

# "High Efficiency ..."

... is really not very high

... is 20% to 60% **LESS** efficient than the best

- ◆ small split systems
- ◆ water cooled chiller systems
- ◆ they could be made (*given a market*)



# Achieving ENERGY EFFICIENCY

- ◆ CAPACITY / SIZE
- ◆ SYSTEM DESIGN
- ◆ MODEL SELECTION
- ◆ INSTALLATION
- ◆ DUCTS
- ◆ OPERATION
- ◆ MAINTENANCE

# CAPACITY / SIZE

## Avoid Over-sizing

- Frequent cycling shortens component life
- Efficiency ratings are at steady-state
- Costs more & uses more power

*Example: compare power draws of 2 units*

15 ton: 15.7 kW

17½ ton: 18.9 kW

Added electric demand of 3.2 kW ~ \$300 per year

Insist that documented sizing calculations be performed using accepted ACCA or ASHRAE procedures. ACCA methods have sufficient built-in safety factors. Use ASHRAE design conditions.

# SYSTEM DESIGN

- ◆ Use manufacturer's performance tables to determine real unit capacity (not nominal rating)
  - ◆ Select the model closest in capacity to the load
- ◆ Specify that TAB shall include supply air CFM, fan RPM, External SP, and EAT-LAT
- ◆ OA CFM must meet ASHRAE 62, provide exhaust makeup, *and* pressurize the building 0.02 to 0.04 in.wg [5 to 10 Pa]
- ◆ Consider **price** to avoid value-*un* engineering

# SYSTEM DESIGN

## ◆ Factory Equipment Options

- Filter pressure drop sensor
- Motorized fresh-air damper with Economizer
- Communications interface
- ~~High Static Drive~~ – Use *static regain* duct design

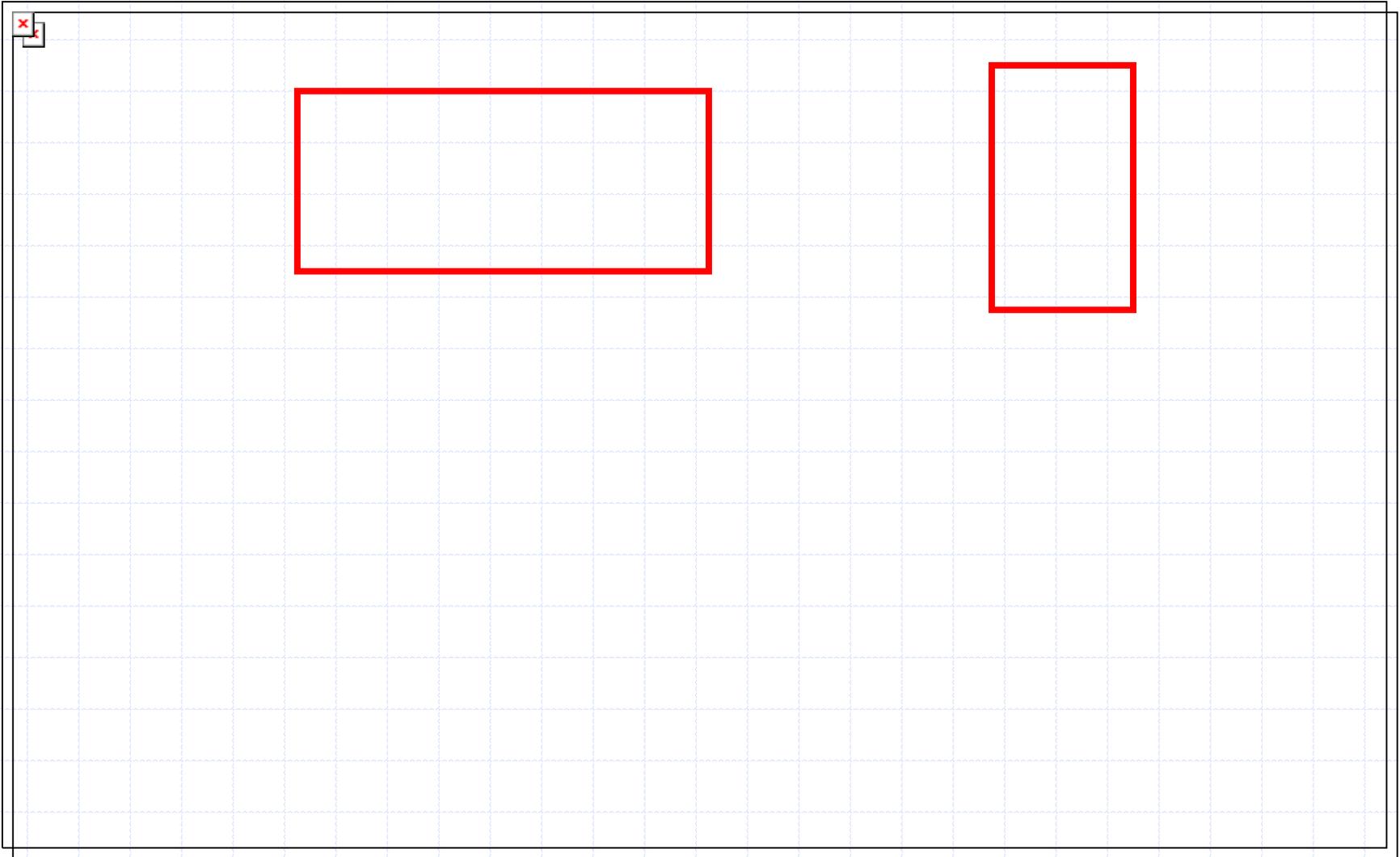
## ◆ After-market Add-ons

- **LPA** liquid pressure amplification
- **EER-Plus** desuperheater / subcooler

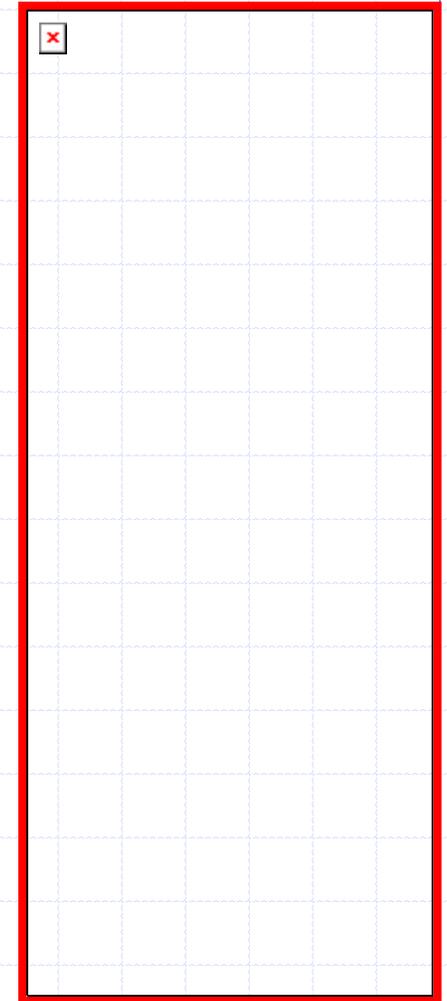
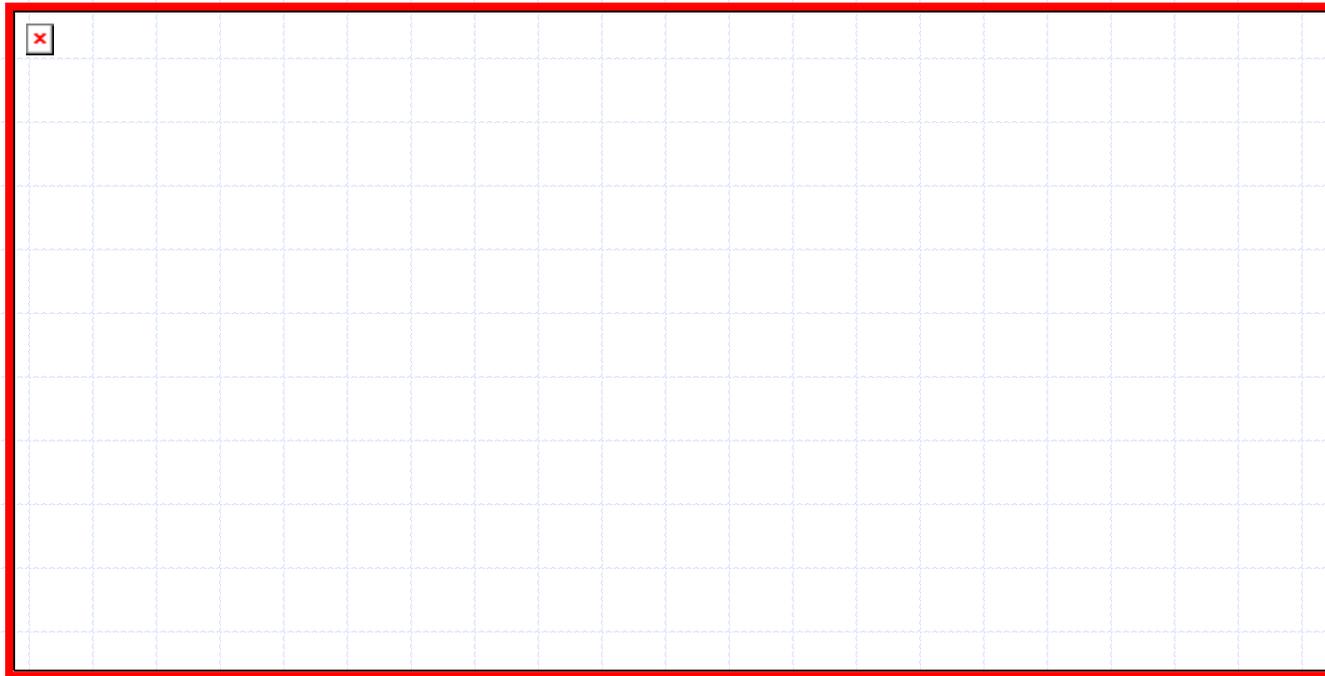
# MODEL SELECTION

- ◆ Efficiency Rating (IPLV, SEER, or EER)
- ◆ Fan motor efficiency rating
  - ◆ Fan is 10 to 20% of unit power draw [kW]
  - ◆ Fan is 20% to 50% of unit energy usage [kWh]
- ◆ Number of Stages
- ◆ Ease of Maintenance
- ◆ Price

# MODEL SELECTION

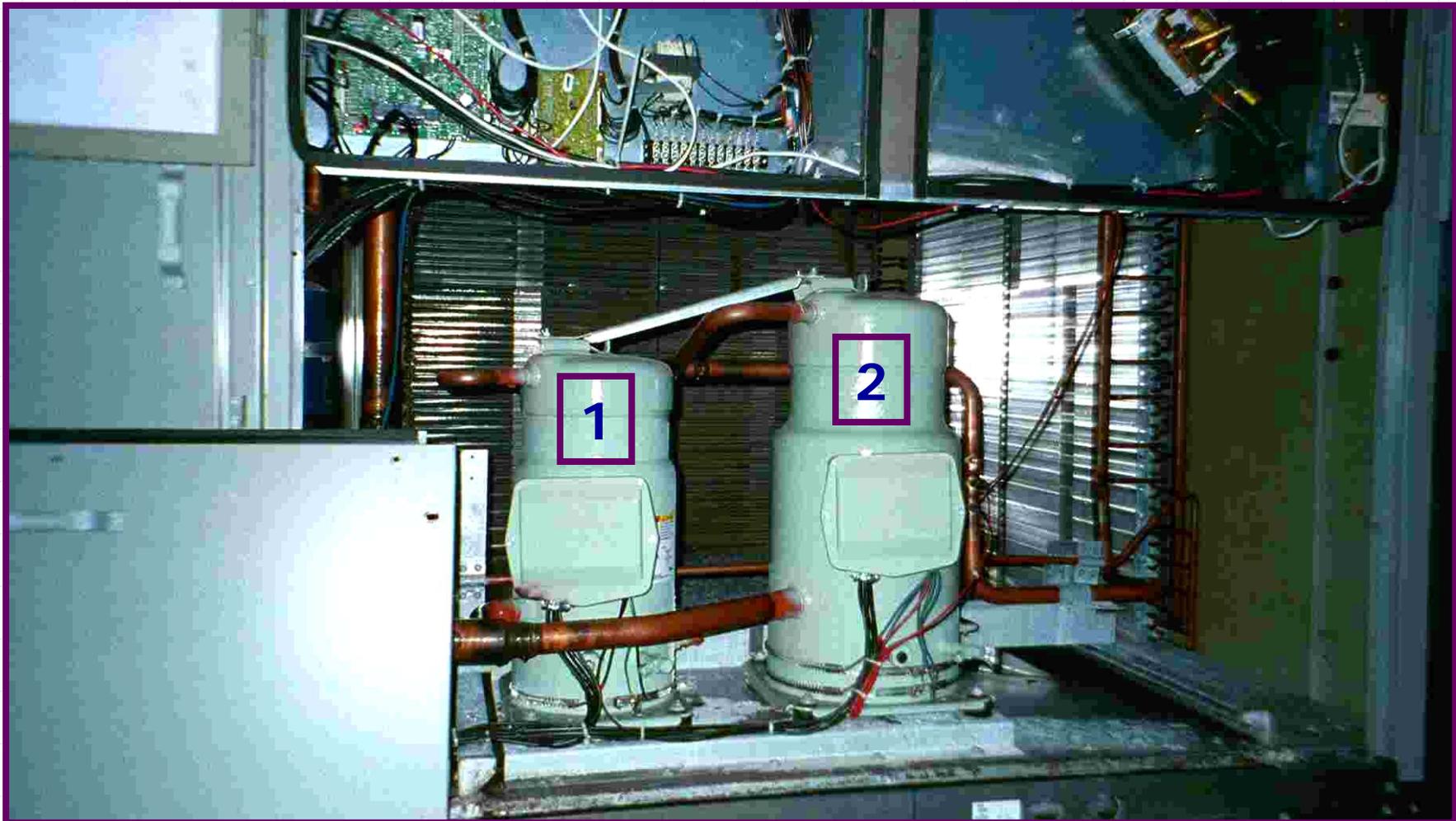


# MODEL SELECTION



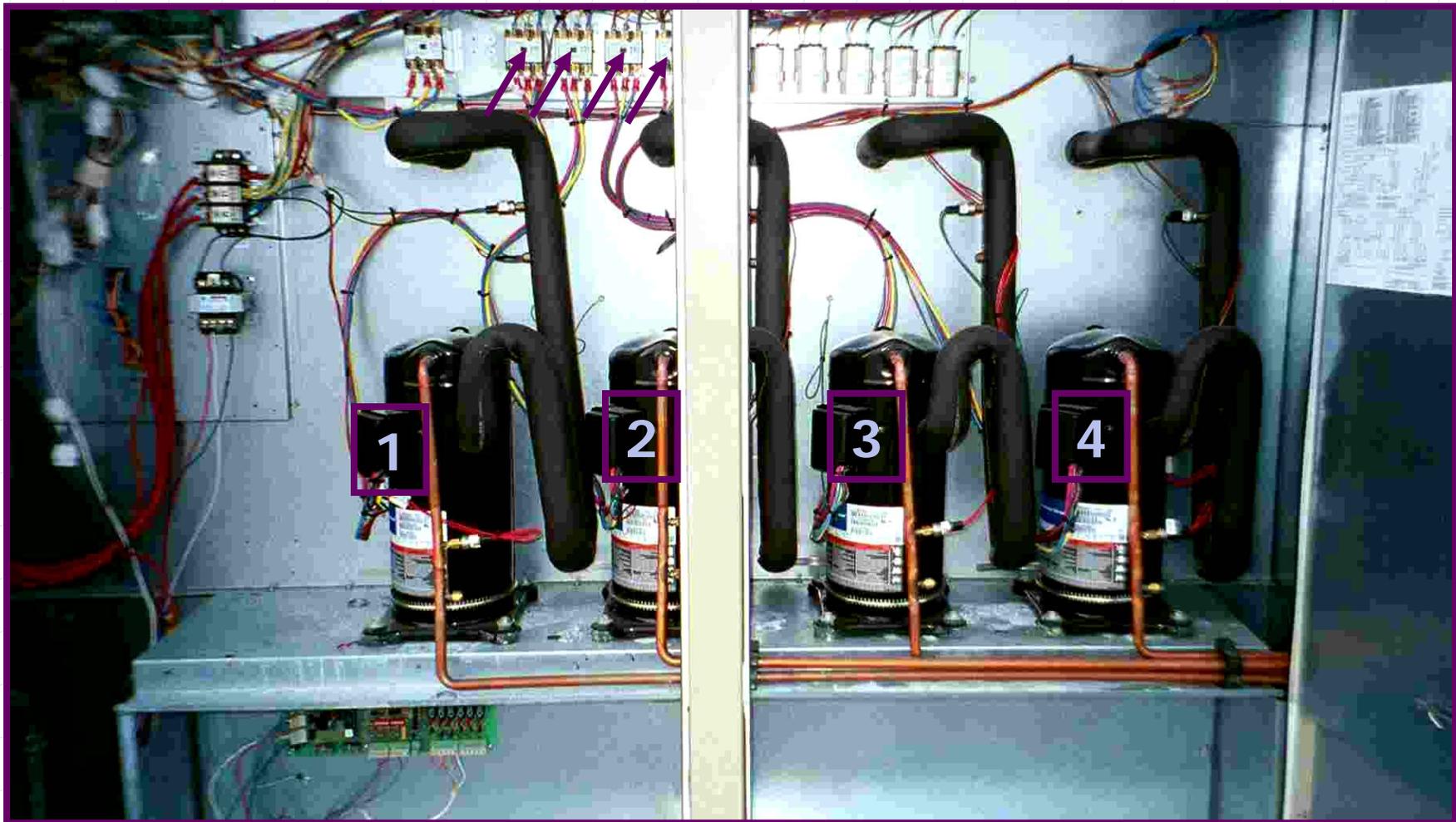
# MODEL SELECTION

This unit has 2-compressors, but only 1 refrigerant circuit



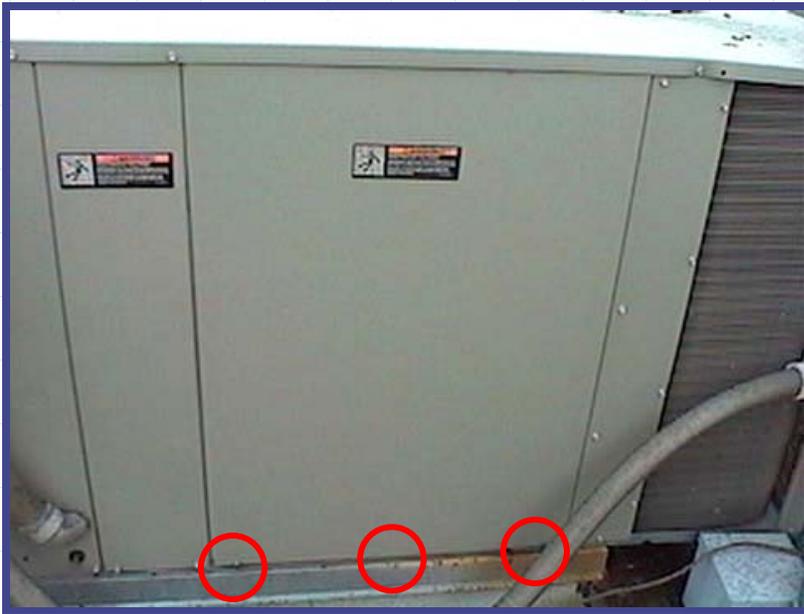
# MODEL SELECTION

This unit has 4 compressors, but only 2 control stages



# MODEL SELECTION

Ease of Maintenance



vs.



# MODEL SELECTION

*Dual Source* - the energy efficiency of ground-source with the low first cost of air-source

- ◆ Uses ground-coupling to extend the delta-T available from ambient air

## Application Example: MS Naval Training Classroom Building

24,730 square feet

Two 35-ton Roof Top Package Units

Electric Cost: STANDARD AC: \$17,600

DUAL-SOURCE: \$12,400 (30%)

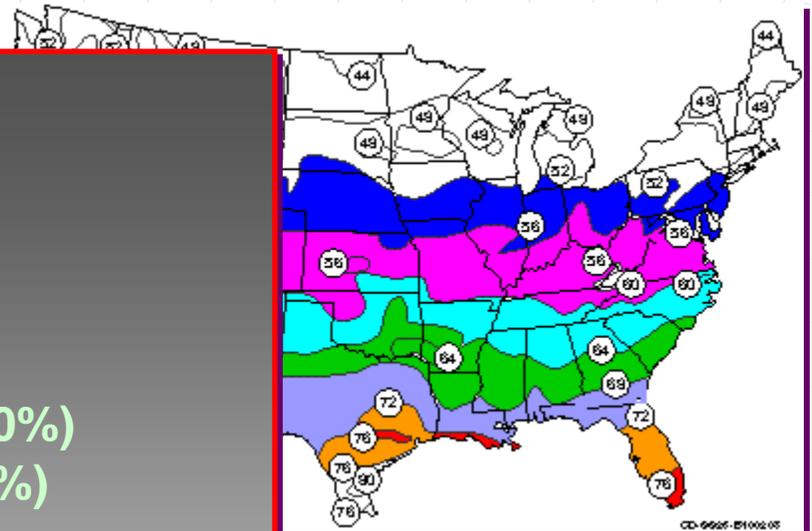
GEOHERMAL: \$8,000 (55%)

## Installed Cost / Payback

STANDARD AC: \$30,000

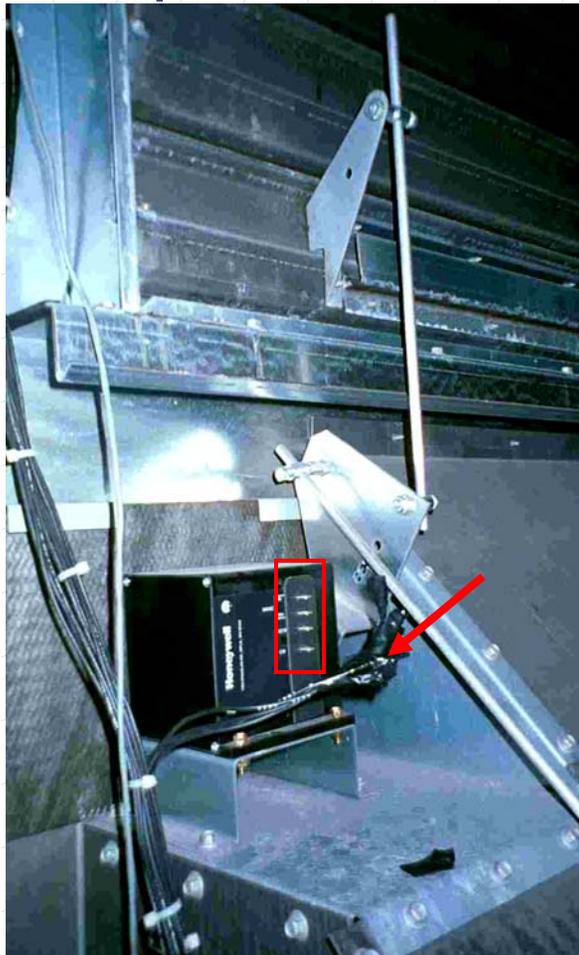
DUAL-SOURCE: \$49,000 / 3.6 years

GEOHERMAL: \$125,000 / 9.9 years



# INSTALLATION

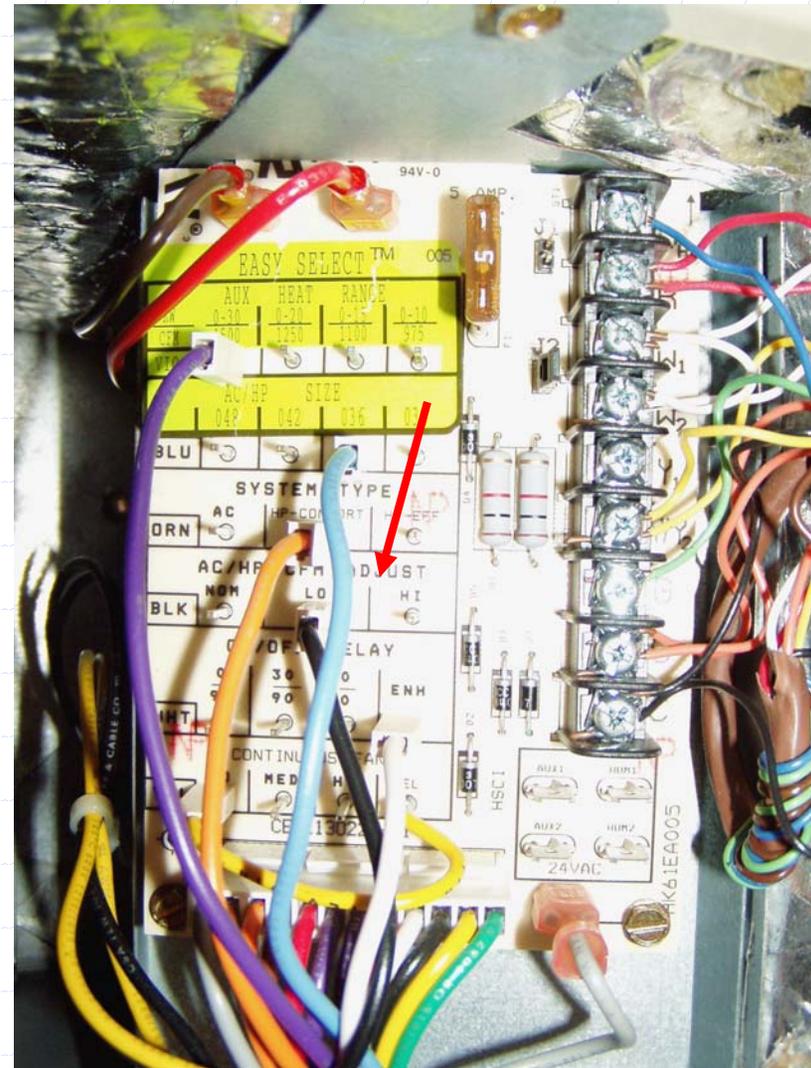
Motorized Fresh-air damper with Economizer



# INSTALLATION

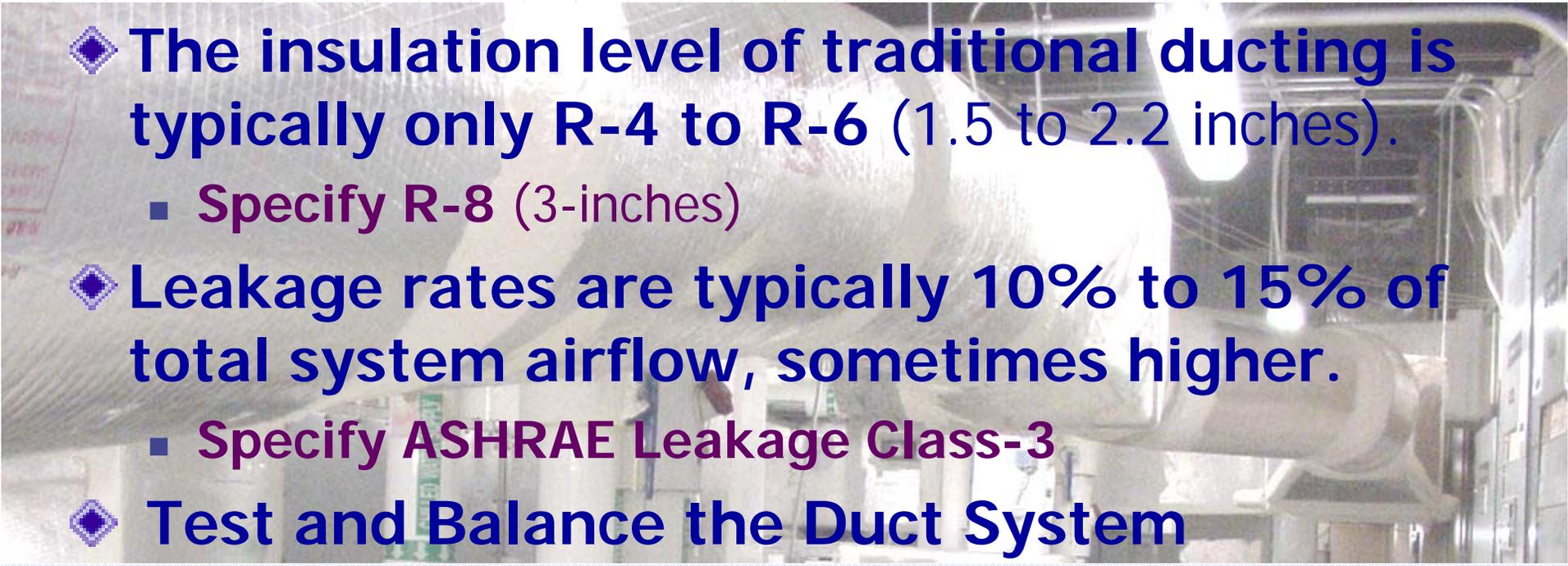
Operating EER can vary up or down by one point with the fan speed setting and proper matching of indoor and outdoor unit sections.

**Check these details to ensure the rated EER is realized.**



# DUCTS

Air leakage and heat gain rob air-conditioning system efficiency.

- 
- ◆ **The insulation level of traditional ducting is typically only R-4 to R-6 (1.5 to 2.2 inches).**
    - **Specify R-8 (3-inches)**
  - ◆ **Leakage rates are typically 10% to 15% of total system airflow, sometimes higher.**
    - **Specify ASHRAE Leakage Class-3**
  - ◆ **Test and Balance the Duct System**

# OPERATION

- Select a thermostat that will retain settings through a power outage, and that has a lockout or adjustment limits
- Program temperatures and occupied / unoccupied periods



# MAINTENANCE

... critical to realizing rated EER for the life of the unit



# MAINTENANCE

- ◆ Numerous energy surveys clearly show that *lack of preventative maintenance is by far the major cause of air conditioning energy waste in FEDERAL buildings.*
- ◆ Common and costly problems include:
  - clogged, corroded cooling and condenser coils
  - sizeable duct leaks and cabinet air leaks
  - low refrigerant, *even in brand-new units*
  - maladjusted air dampers
  - un-calibrated or nonfunctioning thermostats

# RECOMMENDED ACTION PLAN

1. **Determine** the **actual operating efficiency** of installed equipment. Compare with the best new equipment.
2. Identify units that are **candidates for replacement**
  - if existing EER is 4 or more points less than the best new units.
3. Identify units that are **candidates for upgrades**
  - existing EER is 2 to 4 points less than the best new units.
4. Identify units for a **thorough** preventative maintenance **check and tune-up** when the existing EER is within 2 points of the best available units.

# Achieving ENERGY EFFICIENCY With Standard Air-Conditioning Units

## Thank you!



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