



Mechanical/Electrical Energy Auditing 101

(Things to look for other than
Lighting and Water Savings) when
performing an Energy Audit

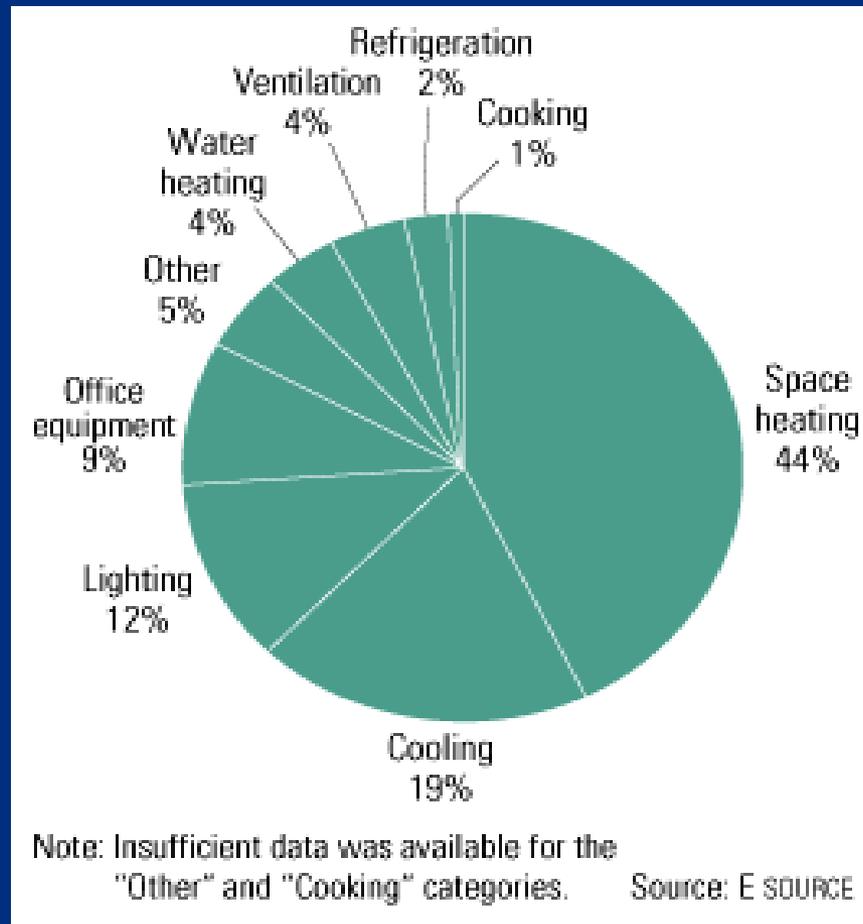


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Mechanical/ Electrical

- Energy Use in buildings for various functions





Overview Mechanical/Electrical

- Building Envelope
 - Windows
 - Roofs & Walls
- HVAC
 - Boilers/Furnaces/Water Heaters
 - Chillers/Air Conditioning
- Electrical Distribution
 - Motors, Wiring & Transformers



Building Envelope

- Windows
 - Single Pane Glass $R = 1$
 - Double Pane Glass $R = 2$
 - Infiltration (loose or tight)
 - Comfort E Glass (effective $R = 4$)
 - Reflective Films (effective $R = 4$)



Building Envelope

- Windows
 - Single Pane Glass

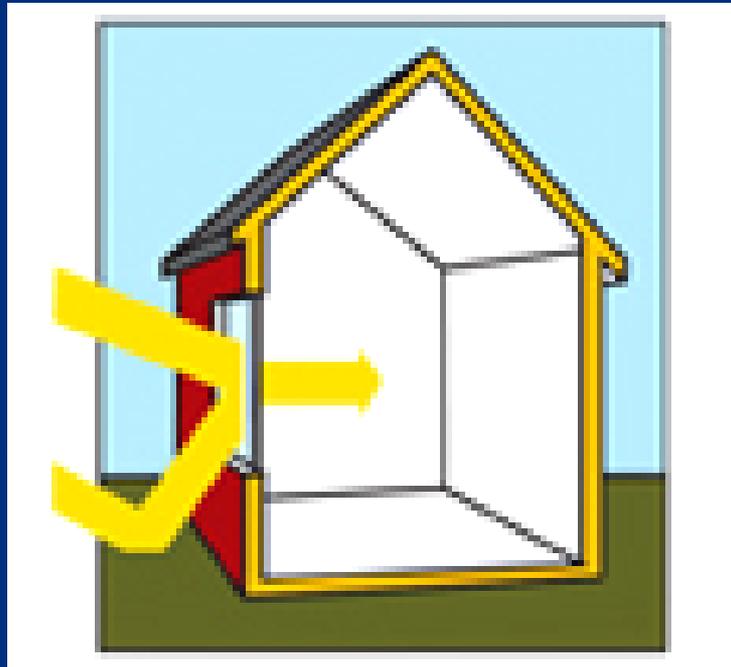


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Building Envelope

- Windows
 - Low E Glass/IR Reflective Films (Summer)





Building Envelope

- Windows
 - Low E Glass/IR Films Winter





Building Envelope

- Roofs and Walls
 - Insulation (at least $R = 30$ roof (12" fiberglass) and $R = 15$ Walls (6" fiberglass) ("Temperate" US)
 - Heat absorption/emission
 - Absorption should be low (Summer)
 - Emission should be low (Winter)



Building Envelope

- Roof Insulation





Building Envelope

- Heat Absorption/Emission





Building Envelope

- Roof Color





Building Envelope

- Roof & Walls
 - Absorption/Emission of Heat





Building Envelope

- Roof and Walls

	Hot Roof Surface (Regressed values)	Cool (White) Roof Surface	Temperature Reduction
Peak Temperatures			
Black Roof	198 °F	120 °F	78 °F
Metal Roof	165 °F	119 °F	46 °F
Avg. Temperatures			
Black Roof	102 °F	85 °F	17 °F
Metal Roof	95 °F	85 °F	10 °F



HVAC

- Boilers/Furnaces/Water Heaters
 - Natural Draft (75%)
 - Forced Draft (85%)
 - Condensing (95%+)



HVAC

- Boilers/Furnaces/Water Heaters
 - Natural Draft
 - (small)





HVAC

- Boilers/Furnaces/Water Heaters
Natural Draft
(large)





HVAC

- Boilers/Furnaces/Water Heaters
 - Forced (small)





HVAC

- Boilers/Furnaces/Water Heaters
Forced Draft
(large)





HVAC

- Boilers/Furnaces/Water Heaters
 - Condensing
 - small





HVAC

- Boilers/Furnaces/Water Heaters
 - Condensing (large)



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HVAC

- Air Conditioning/Chillers
 - Reciprocating (0.9 kW per ton) 50 tons & less
 - Get minimum 16 “SEER” /”Scroll”
 - Screw (0.80 kW per ton) 50-100 tons
 - Centrifugal/Screw (0.5 kW per ton) 100 tons +
 - Free Cooling
 - Cooling Towers
 - Economizers
 - Variable Speed



HVAC

- Reciprocating Air Conditioning (small)

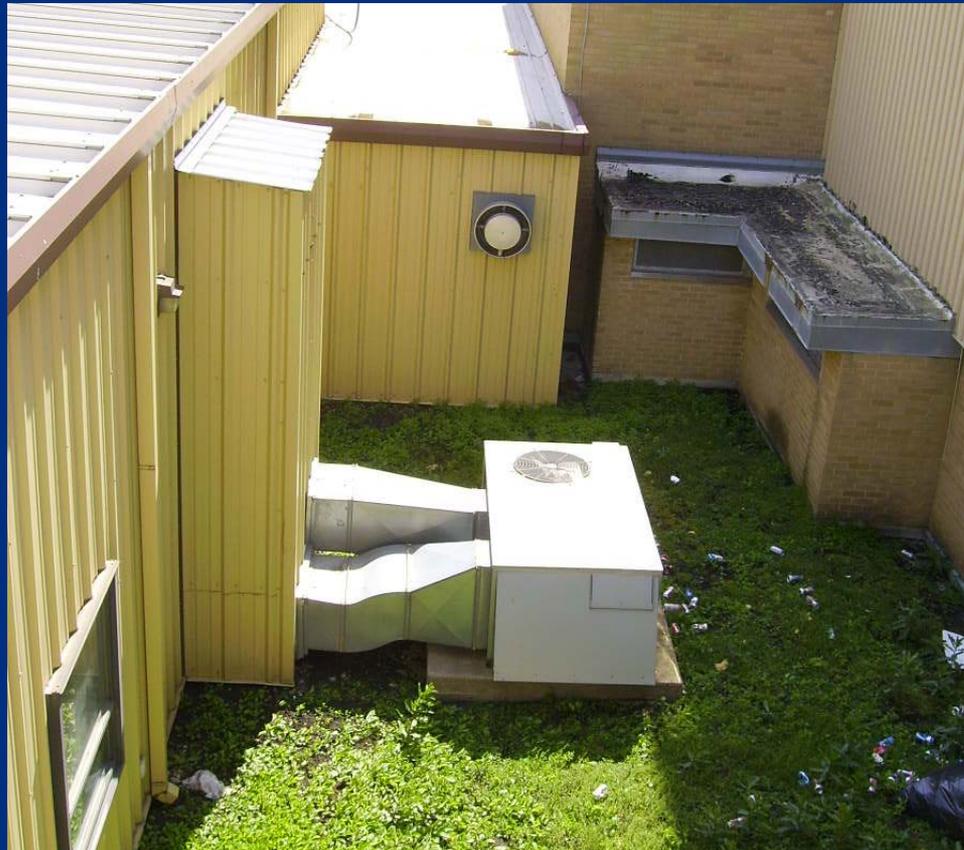


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HVAC

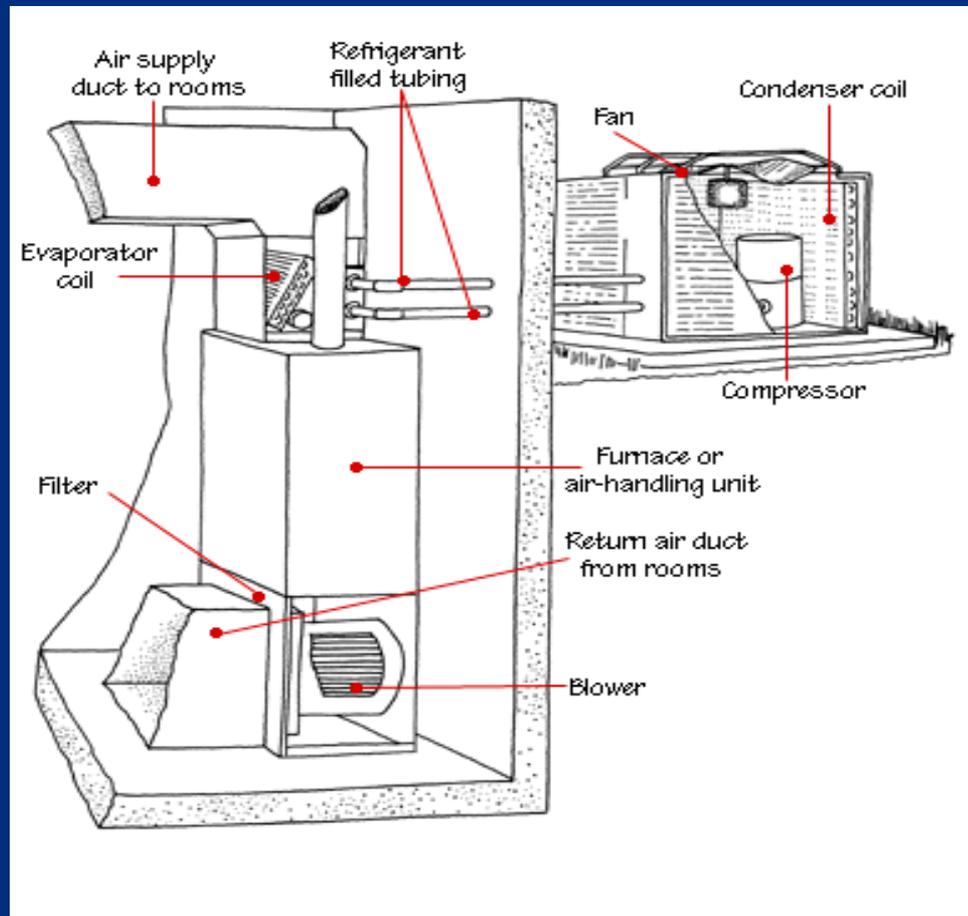
- Reciprocating Air Conditioning (package)





HVAC

- Reciprocating Air Conditioning (split)





HVAC

Reciprocating Air Conditioning

Split

(High E 16+
condenser)



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HVAC

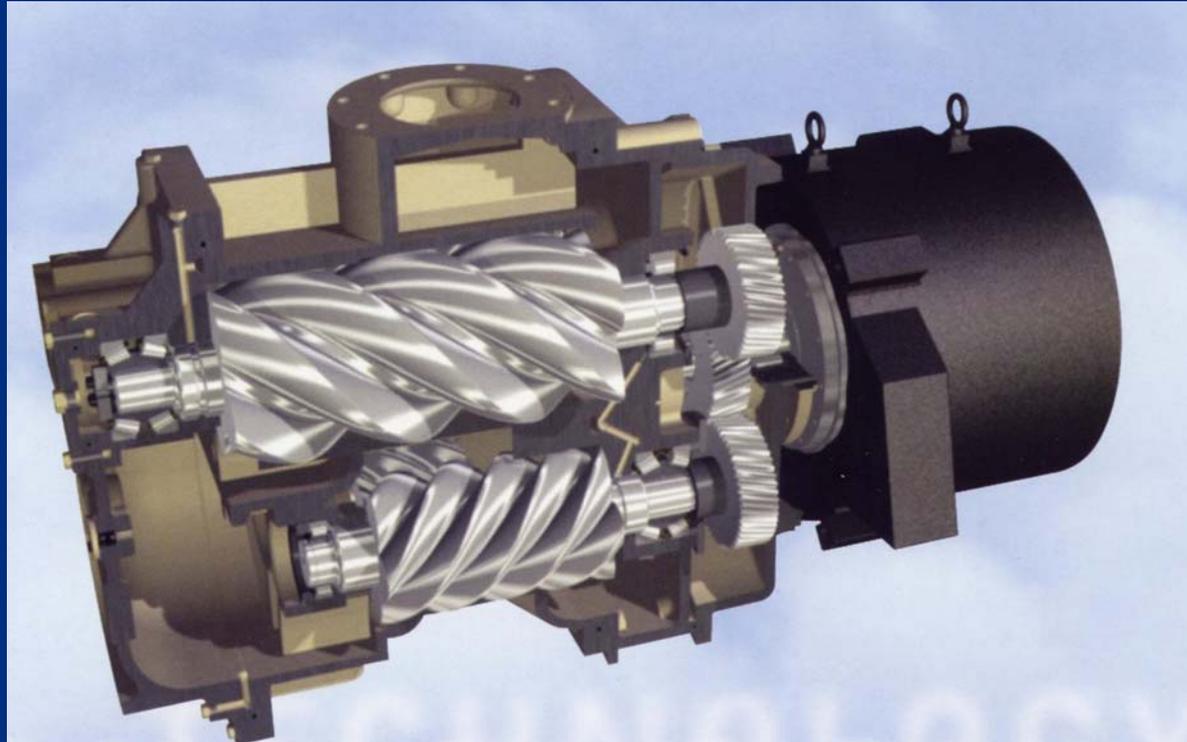
Reciprocating Air Conditioning

- *SEER* (seasonal energy efficiency ratio) measures how efficiently a residential central cooling system (air conditioner or heat pump) will operate over an entire cooling season, as opposed to a single outdoor temperature. As with EER, a higher SEER reflects a more efficient cooling system. SEER is calculated based on the total amount of cooling (in [Btu](#)) the system will provide over the entire season divided by the total number of [watt-hours](#) it will consume:
 - = seasonal Btu of cooling/seasonal watt-hours used



HVAC

- Chillers
 - Screw



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HVAC

- Chillers Screw (0.8 kW/ton or better)



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HVAC

- Centrifugal Chiller (0.5 kW/ton or better)

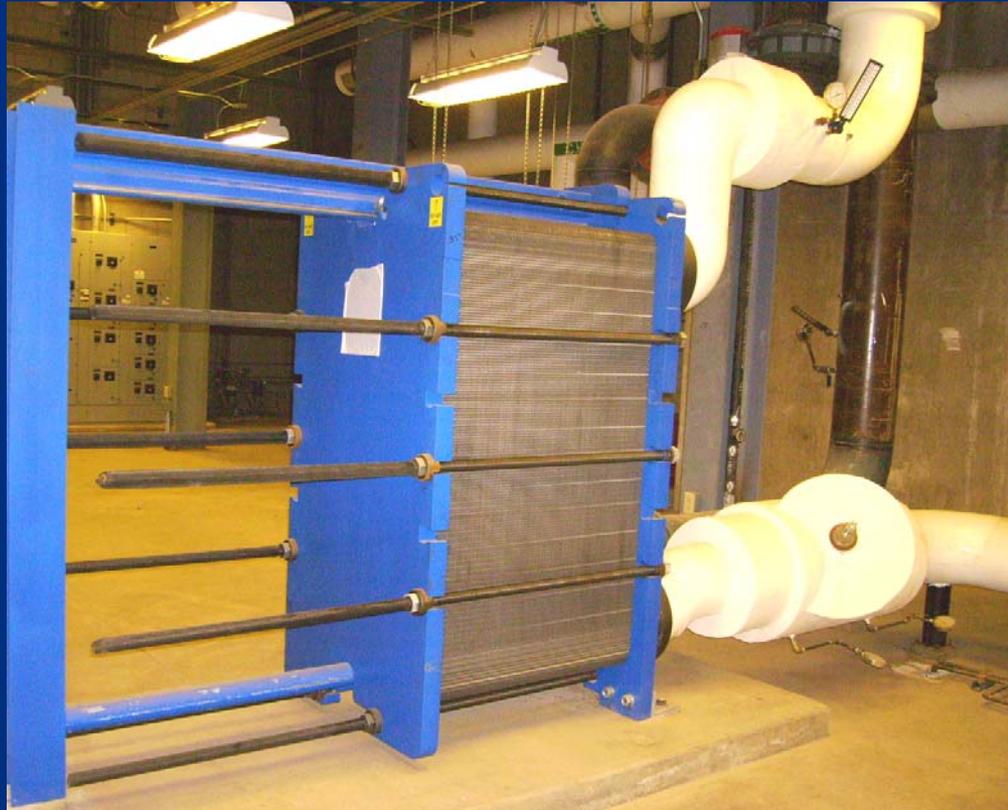


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HVAC

- Free Cooling (water)
 - Using Cooling Towers





HVAC

- Pumps





HVAC

- Cooling Towers



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HVAC

- Variable Speed Drives





HVAC

- Free Cooling
 - Economizers

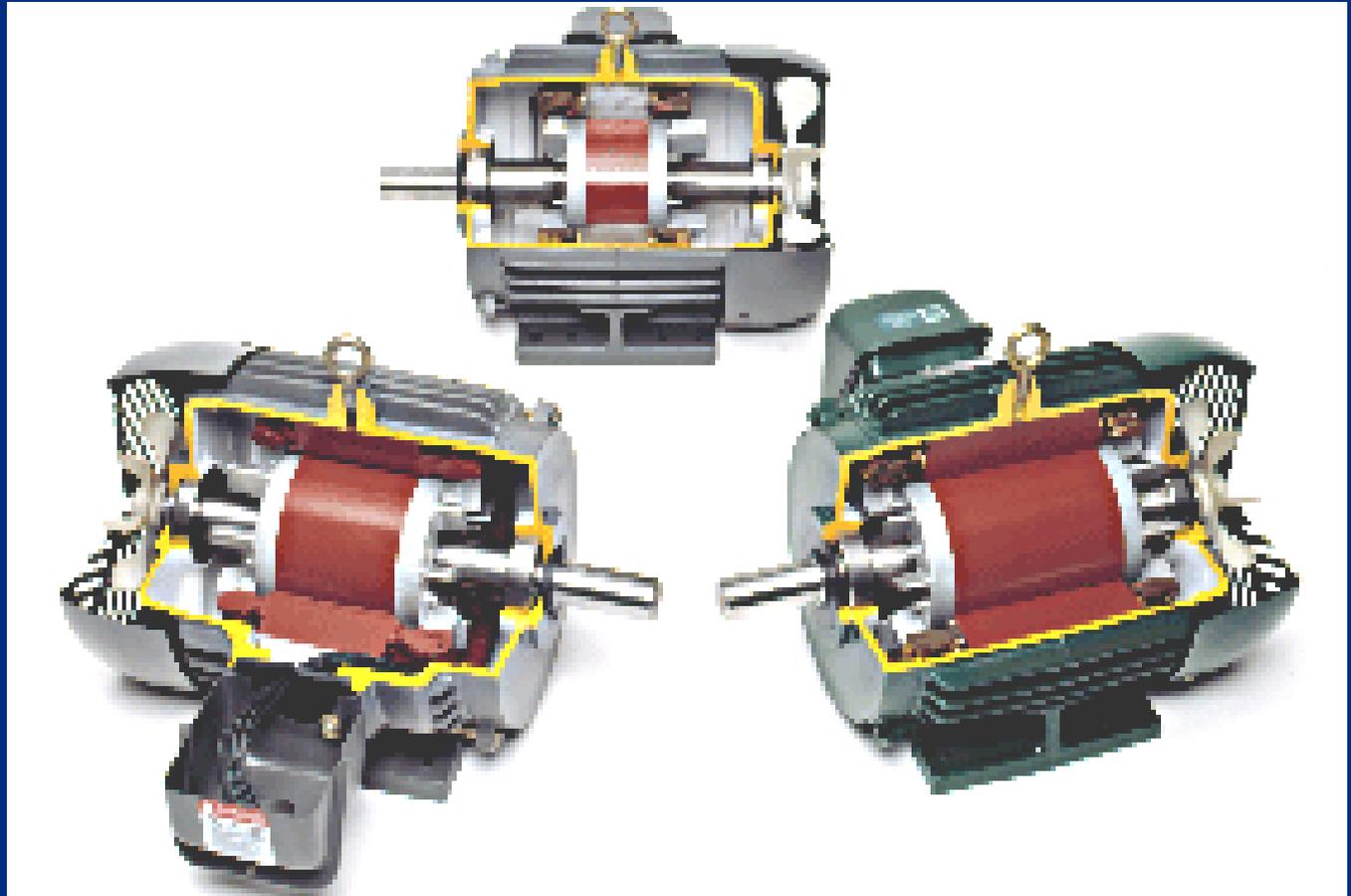


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Electrical Distribution

- Motors



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Electric Distribution

- Motors

Std Efficiency Motors,
Average Efficiency

Replace with NEMA Premium
Motors

Horse Power	Eff. at 75% load	Annual Energy Use (kWh), cost	% Eff at 75% load	Annual Energy Use (kWh), cost	Annual Savings, kWh	Payback Period
5	84.0%	26,644	90.5%	24,729	1,914	2.10 yrs
10	86.8%	51,653	92.2%	48,547	3,106	2.22 yrs
15	87.6%	76,771	92.6%	72,815	3,955	2.11 yrs
20	89.3%	100,206	93.4%	95,846	4,360	2.52 yrs
25	89.9%	124,457	94.0%	119,043	5,415	2.62 yrs
50	91.6%	244,211	94.5%	236,825	7,386	2.42 yrs

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Electrical Distribution

- Transformers





Electric Distribution

- Transformers

Option	Purchase Price	No-Load Losses, watts	Full-Load Losses, watts	One-Year, Operating Cost	15-Year Operating Cost	Total 15-Year Owning Cost
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Low Efficiency	\$1,336	375	2,829	\$1,965	\$29,475	\$30,811
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High Efficiency	\$3,214	190	993	\$725	\$10,875	\$14,084
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For More Information

- Would you like to know more about this session?
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