Building Energy Asset Score: Building Upgrade Guide[1]

HVAC SYSTEMS

A variety of HVAC system upgrades can be considered, depending on the existing configuration. Both equipment replacements and add-on technologies can improve the efficiency of HVAC systems. Some equipment recommendations may suggest implementing the same type of equipment or technology. This implies installing a newer high efficiency version of the current technology. When a "High Efficiency" unit is not specified in an AS report, that unit may not be cost effective. However, it is recommended to consider installing the highest efficiency level when economically feasible.

Cooling

Asset Score Report Recommendations:

Chilled Water Systems

- **Upgrade to High-Efficiency Electric Chiller**
- **Upgrade to New Electric Chiller**

Cost: $$$

Chilled water systems are commonly installed in large buildings (more than 100,000 square feet) and consume a large amount of energy; therefore, efficiency improvements can produce significant savings. While such systems are complex and provide several upgrade opportunities, an integrated approach to upgrades is necessary to ensure that individual components are compatible with overall system efficiency improvements.

Recommendations include upgrading to a higher efficiency chiller of a different type (e.g., from a reciprocating type chiller to a screw or scroll type) or to a new chiller of the same type that improves performance compared to the existing chiller. Specific considerations will vary according to current system configuration, cooling load magnitude, full- vs. part-load operation needs, and potential staging requirements. Tables 4 and 5 provide general guidelines for selecting water and air-cooled chillers.

[1] The complete Asset Score Building Upgrade Guide is available at: https://buildingenergyscore.energy.gov/assets/energy_asset_score_recommendations_guide.pdf

Table 4: General guide for selecting high-efficiency water-cooled chillers

Compressor Type	Capacity (tons)	Full-Load Optimized Applications (kW/ton) products must meet both levels		Part-Load Optimized Applications (kW/ton) products must meet both levels	
		Full-Load Efficiency	IPLV	Full-Load Efficiency	IPLV
Positive Displacement	< 75	≤ 0.75	≤ 0.63	≤ 0.80	≤ 0.60
	75 to 149	≤ 0.71	≤ 0.61	≤ 0.79	≤ 0.51
	150 to 299	≤ 0.68	≤ 0.58	≤ 0.72	≤ 0.50
	≥ 300	≤ 0.58	≤ 0.54	≤ 0.64	≤ 0.48
Centrifugal	< 150	≤ 0.62	≤ 0.60	≤ 0.64	≤ 0.36
	150 to 299	≤ 0.59			≤ 0.35
	300 to 599	≤ 0.56	≤ 0.55	≤ 0.60	≤ 0.36
	≥ 600	≤ 0.55	≤ 0.40	≤ 0.57	≤ 0.350

Source: Federal Energy Management Program (FEMP) (2014) Water-Cooled Electric Chillers. U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. http://energy.gov/eere/femp/covered-product-category-water-cooled-electric-chillers Accessed on June 1, 2015.

Table 5: General guide for selecting high-efficiency air-cooled chillers

	Full-Load Optimized Applications products must meet both levels		Part-Load Optimized Applications products must meet both levels	
Chiller Capacity	Full Load Efficiency	IPLV	Full Load Efficiency	IPLV
< 150 tons	≤ 1.15 kW/ton (≥ 10.40 EER)	≤ 0.96 kW/ton (≥ 12.50 EER)	≤ 1.25 kW/ton (≥ 9.56 EER)	≤ 0.78 kW/ton (≥ 15.39 EER)
≥ 150 tons		≤ 0.94 kW/ton (≥ 12.75 EER)		≤ 0.80 kW/ton (≥ 15.07 EER)
You may choose to use either the cooling capacity (kW/ton) or the Energy Efficiency Ratio (EER; Btu/watt) to determine a product's compliance.[b]				

[a] Values are based on standard rating conditions as specified in Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 550/590. Only packaged chillers (i.e., none with remote condensers) are covered.
[b] Performance requirements are provided in both kilowatt (kW)/ton and energy efficiency ratio (EER or Btu/watt) units for convenience. When comparing air-cooled and water-cooled chillers, kW/ton is a common metric. When comparing only air-cooled chillers, EER (Btu/watt) is a common metric.

Source: Federal Energy Management Program (FEMP) (2014) Air-Cooled Electric Chillers. U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. http://energy.gov/eere/femp/covered-product-category-air-cooled-electric-chillers Accessed on June 1, 2015.

Add Variable Frequency Drive (VFD) to Cooling Tower Fan
Cost: $$

Many older cooling towers use constant speed (on/off) or two-speed (high/low/off) fans that cycle to maintain the condenser water supply temperature setpoint. Adding VFDs to the cooling tower fans and varying fan speed to maintain the condenser water supply temperature setpoint saves energy with no associated pump penalty or sacrifice in performance.

Add Variable Frequency Drive to Condenser Pumps
Cost: $$

This measure applies to cooling plants that use water-cooled chillers and require pumping of water to the cooling towers. Many older cooling towers use constant speed (on/off) or two-speed (high/low/off) pumps; upgrading these to variable speed pumps will improve performance and reduce energy use at part load conditions.

Upgrade Cooling Plant Pumping System to Constant Primary - Variable Secondary Pumping System
Cost: $$

This measure applies to cooling plants that use chillers. Chilled water pumping systems generally fall into one of two categories: primary-only and primary-secondary. In primary-only systems, one set of pumps circulates chilled water between the chiller(s) and the air handler(s). These systems can be either constant flow or variable flow. In primary-secondary systems, the primary pumps circulate chilled water through the chiller(s), and the secondary pumps draw from that loop to circulate chilled water to the air handler(s). In general, primary-only variable flow systems use less energy than primary-only constant flow and primary-secondary systems, due to reduced pumping energy usage. However, they are usually more complicated to design and operate. They are generally better suited for larger facilities with multiple chillers.