# Recommendation ${REC}: Replace Old HVAC Units

### Recommended Action

Replace the old air conditioning units with new, efficient units to save energy.

### Summary of Estimated Savings and Implementation Costs

|  |  |
| --- | --- |
| Recommendation Type | HVAC |
| Annual Cost Savings | ${ACS} |
| Implementation Cost | ${MIC} |
| Payback Period | ${MPB} |
| Annual Electricity Savings | ${ES} kWh |
| Annual Demand Savings | ${DS} kW |
| ARC Number | 2.7232.3 |

### Current Practice and Observations

Currently, the plant has many air conditioner units in service. During the plant visit, we were informed that some of these HVAC systems are very old and inefficient, relative to air conditioners currently being sold by manufacturers. It is recommended that the air conditioners that are close to the end of their lifespan be replaced. The energy cost savings from higher efficiency units will help pay for the incremental cost. It is recommended that the old AC units be replaced with new, energy-efficient units with make-up air capabilities. The designated unit is #3. The HVAC systems run 24/7 year-round based on the factory conditions and the control system for the units.

### Anticipated Savings

The EER of the air conditioning units can be obtained from the Directory of Certified Applied Air Conditioning Products, manufacturer’s literature, or is included on the yellow appliance rating label of the unit. It is very common to find newer units with an EER of 12, and some of the latest models have an EER as high as 16. It is recommended that the older units be replaced with new units that have a minimum EER of 15.

Since we could not perform tests on the present efficiency of the system, the following equation[[1]](#footnote-1) is used to calculate the approximate current Energy Efficiency Ratio (EERc) of the system.

EERc = (Base EERb) × (1 – M)age,

where,

EERb = EER when the HVAC system is new, see table below

<mfalse> M = Maintenance Factor, M = 0.03

(Annual Professional Maintenance, M = 0.01)

(Seldom or Never Maintained, M = 0.03)</mfalse><mtrue> M = Maintenance Factor, M = 0.01

(Annual Professional Maintenance, M = 0.01)

(Seldom or Never Maintained, M = 0.03)</mtrue>

Age = Age of HVAC system under consideration (in years): see Tables below.

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| --- | --- | --- | --- | --- | --- | --- |
| Name | HVAC Size (Tons) | HVAC Size (Btu/hr) | Age (years) | Assumed Base EER | Estimated Current EER | Proposed EER |
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| Total | **${TTON}** | **${CC}** |  |  |  |  |

**Table 1: Existing HVAC Equipment.**

The annual demand savings, DS, to be achieved replacing the HVAC units is calculated as follows:

1 Ton = 12,000 Btu/hr

CED = Current Electrical Demand = ∑ (CC × C1 × LF / EERC)

PED = Proposed Electrical Demand = ∑ (CC × C1 × LF / EERP)

where,

CC = Cooling capacity: see existing HVAC equipment table

C1 = Conversion factor: 0.001 kW/W

LF = Load factor: ${LF}%.

EERC = Current energy efficient ratio (Btu/h/W): see existing HVAC equipment table

EERP = Current energy efficient ratio (Btu/h/W): see existing HVAC equipment table

CED = ∑ (CC × C1 × LF / EERC)

= ${CED}

PED = ∑ (CC × C1 × LF / EERP)

= ${PED}

OH = Operating hours: ${OH} hrs/yr (${HR} hrs/day, ${DY} days/wk, ${WK} wks/yr)

CF = Coincidence factor: probability that the equipment contributes to the peak demand: ${CF}%

C2 = Conversion factor: ${CS} months/year for cooling season

ES = Annual Energy Savings = (CED **-** PED) × OH,

= (${CED} kW - ${PED} kW) × ${OH} hrs/yr

= ${PR} kW × ${OH} hrs/yr

= ${ES} kWh/yr

DS = Annual Demand Savings = (CED **-** PED) × CF × C2

= (${CED} kW - ${PED} kW) × CF × C2

= ${PR} kW × ${CF}%/mo × ${CS} mos/yr

= ${DS} kW/yr

The energy cost savings, ECS, and the demand cost savings, DCS, are calculated as follows:

ECS = EC × ES

DCS = DC × DS,

where,

EC = Electricity cost: ${EC}/kWh

DC = Demand cost: ${DC}/kW

ECS = ${EC}/kWh × ${ES} kWh/yr

= ${ECS}/yr

DCS = ${DC}/kW× ${DS} kW/yr

= ${DCS}/yr.

The total cost savings per year, ACS, is as follows:

ACS = ECS + DCS

= ${ACS}/yr.

**Implementation Cost**

The older units should be replaced with a high efficiency HVAC unit. There are several brands, prices, and models available; however, an average installed cost of ${UC}/ton is assumed. Therefore, the total cost for the current HVAC units will be about ${IC}.<REBATE>

However, there could be energy efficiency rebates available through your utility company, which could potentially reduce the overall capital cost and thereby the payback period. The savings from the rebate is calculated below.

RB = ${ERR}⋅yr/kWh × ES

= ${ERR}⋅yr/kWh × ${ES} kWh/yr

= ${RB}

The incentives are capped at 50% of the project cost, which makes the modified rebate savings, MRB, equal to ${MRB}. Hence, the modified implementation cost, MIC, is estimated as follows:

MIC = IC - MRB

= ${IC} - ${MRB}

= ${MIC}

The modified implementation cost is ${MIC}.</REBATE>

**The annual electricity savings for this recommendation is ${ES} kWh, and the annual demand savings is ${DS} kW. The total annual cost savings is ${ACS} and, with an implementation cost of ${MIC}, the payback period is about ${MPB}.**

**Implementation Cost References:**

* <https://www.grainger.com/product/GOODMAN-Air-Conditioner-Condensing-38GM29>
* <https://www.amazon.com/Ton-Seer-Goodman-Package-Conditioner/dp/B006X1AZOQ>
* <https://www.bid-on-equipment.com/hvac-equipment/package-hvac-units/380881~10-ton-trane-packaged-rooftop-unit.htm>

1. https://www.nrel.gov/docs/fy06osti/38238.pdf. [↑](#footnote-ref-1)