# Chiller Retrofit Energy Savings

*Base Case Energy Use* = $T_e$(tons) x $E_e$(kW/ton) x LF x Hrs

*Where*

*$T_e$ = existing chiller cooling tons*
*$E_e$ = existing chiller efficiency in kW/ton*
*y = age of chiller*
*LF = load factor of chillers*
*Hrs = annual hours of operation*

*New Chiller Energy Use* = $T_n$(tons) x $E_n$(kW/ton) x LF x Hrs

*Where*

*$T_n$ = new chiller cooling tons*
*$E_n$ = new chiller efficiency in kW/ton*

*Energy Savings* = Base Case Energy Use – New Chiller Energy Use

Assume the existing chiller is a 150-ton water-cooled centrifugal chiller that is 12 years old. The original efficiency of 0.85 kW/ton. The load factor is 0.75. Operating hours are 3000 hours/year.

The new chiller is an improved efficiency 150-ton water-cooled centrifugal chiller with efficiency of 0.56 kW/ton. This is more efficient than the federal standard at the time of installation of the new unit, which is 0.7 kW/ton.

A chiller EUL is 20 years. Calculating simple payback is a matter of determining energy savings and annual cost savings and then multiplying by the 20 year EUL.

**Existing Chiller**
((150 x 0.85) x (0.75 x 3,000) =
127.5 x 2,250 =
286,875 kWh/yr

**New Chiller**
(150 x 0.56) x (0.75 x 3,000) =
84.0 x 2,250 =
189,000 kWh/yr

**Energy savings = 286,875 – 189,000 = 97,875 kWh/yr**
**Simple Payback = 97,875 kWh/yr @ $.085/kWh = $8,319.00/yr**
**Chiller Life Time Savings 20 Yr = $8,319 x 20 = $166,380 or 1,957,500 kWh**

Depending on policy decisions, one way to determine lifetime savings is to calculate the savings between the 0.85 kW/ton and 0.56 kW/ton units for 8 years (8 years of life are remaining in the unit that is retiring early). For the remaining 12 years of the new chiller, the savings is calculated as the difference between the federal standard and the new unit.

**Existing Chiller with 8 EUL**
(150 x 0.85) x (0.75 x 3,000) =
127.5 x 2,250 =
286.875 kWh/yr.

**New Chiller**
(150 – 0.56) x (0.75 x 3,000) =
84.0 x 2,250 =
189,000 kWh/yr
Energy Savings = 286,875 – 189,000 = 97,875 kWh/yr

**Energy savings years 1-8 = 286.175 – 189,000 = 97,875 kWh/yr x 8 = 783,000 kWhr**
**Cost Savings over 8 years @ $0.085 = $66,555.00**

**Federal Std Chiller**
(150 – 0.7) x (0.75 x 3,000) =
105 x 2,250 =
236,250 kWh/yr

**New Chiller**
(150 – 0.56) x (0.75 x 3,000) =
84.0 x 2,250 =
189,000 kWh/yr
Energy Savings = 236,250 - 189,000 = 47,250 kWh/yr

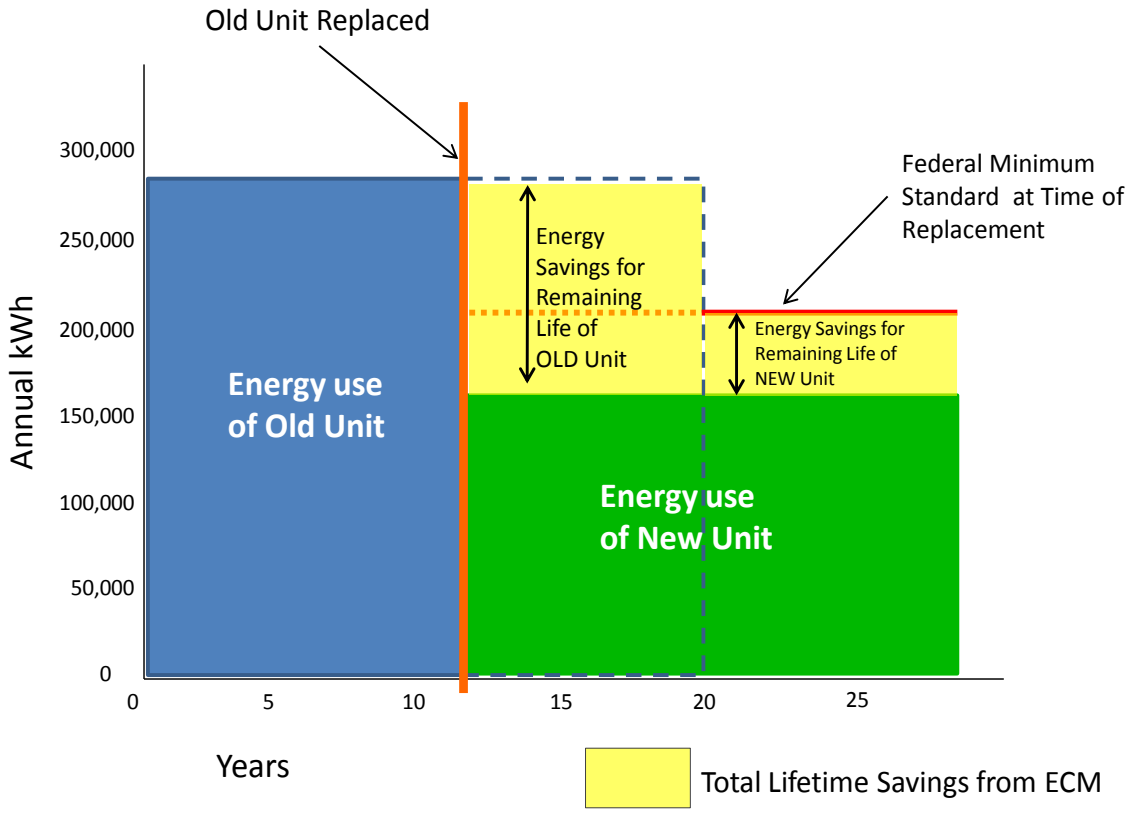
**Energy Savings years 9-20 = 236,250 -189,000 = 47,250 kWh/yr x 12 = 567,000 kWh**
**Cost Savings over 12 years @ $0.085 = $48,195.00**

**<u>SUMMARY SAVINGS using EUL/RUL</u>**
Energy Savings over 8 years EUL =783,000 kWh
Cost Savings over 8 years @ $0.085 = $66,555.00

Energy Savings over RUL of 12 years = 567,000 kWh
Cost Savings over RUL of 12 years = $48,195.00

Total Energy Savings attributable to New Chiller
Over 20 yr Life 783,000 kWh + 567,000 kWh = 1,350,000 kWh
Energy Savings over Life of 20 years = $114,750.00

***Energy Costs ignore any Escalation in Rates***


Old Unit Replaced
Federal Minimum Standard at Time of Replacement
Energy Savings for Remaining Life of OLD Unit
Energy Savings for Remaining Life of NEW Unit
Energy use of Old Unit
Energy use of New Unit
Annual kWh
300,000
250,000
200,000
150,000
100,000
50,000
0
0
5
10
15
20
25
Years
Total Lifetime Savings from ECM