### Central Air Conditioning > 14.5 SEER

**Description**

This measure characterizes:

1. Time of Sale:
   1. The installation of a new residential sized (<= 65,000 Btu/hr) Central Air Conditioning ducted split system meeting ENERGY STAR efficiency standards presented below. This could relate to the replacement of an existing unit at the end of its useful life, or the installation of a new system in a new home.
2. Early Replacement:

Early Replacement determination will be based on meeting the following conditions:

* + - The existing unit is operational when replaced, or
    - The existing unit requires minor repairs (<$734)[[1]](#footnote-1).
    - All other conditions will be considered Time of Sale.

The Baseline SEER of the existing Central Air Conditioning unit replaced:

* + - If the SEER of the existing unit is known and <=10, the Baseline SEER is the actual SEER value of the unit replaced. If the SEER is >10, the Baseline SEER = 13.
    - If the SEER of the existing unit is unknown and the install date of the existing unit is <2007, the Baseline SEER = 10.
    - If the operational status, repair cost or SEER of the existing unit is unknown, the Baseline SEER = 13.

A weighted average early replacement rate is provided for use when the actual baseline early replacement rate is unknown[[2]](#footnote-2).

**Deemed Early Replacement Rates For CAC Units in Combined System Replacement (CSR) Projects**

|  |  |
| --- | --- |
| **Replacement Scenario for the CAC Unit** | **Deemed Early Replacement Rate** |
| Early Replacement Rate for a CAC unit when the CAC unit is the Primary unit in a CSR project | 14% |
| Early Replacement Rate for a CAC unit when the CAC unit is the Secondary unit in a CSR project | 40% |

This measure was developed to be applicable to the following program types:  TOS, NC, EREP.  If applied to other program types, the measure savings should be verified.

**Definition of Efficient Equipment**

In order for this characterization to apply, the efficient equipment is assumed to be a ducted split central air conditioning unit meeting the minimum ENERGY STAR efficiency level standards; 14.5 SEER and 12 EER.

**Definition of Baseline Equipment**

The baseline for the Time of Sale measure is based on the current Federal Standard efficiency level; 13 SEER and 11 EER.

The baseline for the early replacement measure is the efficiency of the existing equipment for the assumed remaining useful life of the unit and the new baseline as defined above[[3]](#footnote-3) for the remainder of the measure life.

**Deemed Lifetime of Efficient Equipment**

The expected measure life is assumed to be 18 years [[4]](#footnote-4).

Remaining life of existing equipment is assumed to be 6 years[[5]](#footnote-5).

**Deemed Measure Cost**

Time of sale: The incremental capital cost for this measure is dependent on efficiency. Assumed incremental costs are provided below[[6]](#footnote-6):

|  |  |
| --- | --- |
| **Efficiency Level** | **Incremental Cost** |
| SEER 14 | $492 |
| SEER 15 | $1008 |
| SEER 16 | $1,383 |
| SEER 17 | $2,378 |
| SEER 18 | $3,154 |

Early replacement: The full install cost for this measure is the actual cost of removing the existing unit and installing the new one. If this is unknown, assume as follows:[[7]](#footnote-7)

|  |  |
| --- | --- |
| **Efficiency Level** | **Full Install Cost** |
| SEER 14 | $4,162 |
| SEER 15 | $4,678 |
| SEER 16 | $5,053 |
| SEER 17 | $6,047 |
| SEER 18 | $6,823 |

Assumed deferred cost (after 6 years) of replacing existing equipment with new baseline unit is assumed to be $3,670[[8]](#footnote-8). This cost should be discounted to present value using the utilities’ discount rate.

**Loadshape**

Loadshape R08 - Residential Cooling

**Coincidence Factor**

The summer peak coincidence factor for cooling is provided in two different ways below. The first is used to estimate peak savings during the utility peak hour and is most indicative of actual peak benefits, and the second represents the *average* savings over the defined summer peak period, and is presented so that savings can be bid into PJM’s Forward Capacity Market.

CFSSP = Summer System Peak Coincidence Factor for Central A/C (during system peak hour)

= 68%[[9]](#footnote-9)

CFPJM = PJM Summer Peak Coincidence Factor for Central A/C (average during PJM peak period)

= 46.6%[[10]](#footnote-10)

**Algorithm**

**Calculation of Savings**

**Electric Energy Savings**

Time of sale:

ΔkWH = (FLHcool \* Btu/hr \* (1/SEERbase - 1/SEERee))/1000

Early replacement[[11]](#footnote-11):

ΔkWH for remaining life of existing unit (1st 6 years):

=((FLHcool \* Capacity \* (1/SEERexist - 1/SEERee))/1000);

ΔkWH for remaining measure life (next 12 years):

= ((FLHcool \* Capacity \* (1/SEERbase - 1/SEERee))/1000)

Where:

FLHcool = Full load cooling hours

= dependent on location and building type[[12]](#footnote-12):

| **Climate Zone**  **(City based upon)** | **FLHcool (single family)** | **FLHcool (multi family)** |
| --- | --- | --- |
| 1 (Rockford) | 512 | 467 |
| 2 (Chicago) | 570 | 506 |
| 3 (Springfield) | 730 | 663 |
| 4 (Belleville) | 1035 | 940 |
| 5 (Marion) | 903 | 820 |
| Weighted Average[[13]](#footnote-13) | 629 | 564 |

Capacity = Size of new equipment in Btu/hr (note 1 ton = 12,000Btu/hr)

= Actual installed, or if actual size unknown 33,600Btu/hr for single-family buildings[[14]](#footnote-14)

SEERbase = Seasonal Energy Efficiency Ratio of baseline unit (kBtu/kWh)

= 13[[15]](#footnote-15)

SEERexist = Seasonal Energy Efficiency Ratio of existing unit (kBtu/kWh)

= Use actual SEER rating where it is possible to measure or reasonably estimate. If unknown assume 10.0[[16]](#footnote-16).

SEERee = Seasonal Energy Efficiency Ratio of ENERGY STAR unit (kBtu/kWh)

= Actual installed or 14.5 if unknown

Time of sale example: a 3 ton unit with SEER rating of 14.5, in unknown location:

ΔkWH = (629 \* 36,000 \* (1/13 – 1/14.5)) / 1000

= 180 kWh

Early replacement example: a 3 ton unit, with SEER rating of 14.5 replaces an existing unit in unknown location:

ΔkWH(for first 6 years) = (629 \* 36,000 \* (1/10 – 1/14.5)) / 1000

= 702 kWh

ΔkWH(for next 12 years) = (629 \* 36,000 \* (1/13 – 1/14.5)) / 1000

= 180 kWh

Therefore savings adjustment of 26% (180/702) after 6 years.

**Summer Coincident Peak Demand Savings**

Time of sale:

ΔkW = (Capacity \* (1/EERbase - 1/EERee))/1000 \* CF

Early replacement[[17]](#footnote-17):

ΔkW for remaining life of existing unit (1st 6 years):

= ((Capacity \* (1/EERexist - 1/EERee))/1000 \* CF);

ΔkW for remaining measure life (next 12 years):

= ((Capacity \* (1/EERbase - 1/EERee))/1000 \* CF)

Where:

EERbase = EER Efficiency of baseline unit

= 11.2 [[18]](#footnote-18)

EERexist = EER Efficiency of existing unit

= Actual EER of unit should be used, if EER is unknown, use 9.2[[19]](#footnote-19)

EERee = EER Efficiency of ENERGY STAR unit

= Actual installed or 12 if unknown

CFSSP = Summer System Peak Coincidence Factor for Central A/C (during system peak hour)

= 68%[[20]](#footnote-20)

CFPJM    = PJM Summer Peak Coincidence Factor for Central A/C (average during peak period)

= 46.6%[[21]](#footnote-21)

Time of sale example: a 3 ton unit with EER rating of 12:

ΔkW SSP = (36,000 \* (1/11.2– 1/12)) / 1000 \* 0.68

= 0.146 kW

ΔkW PJM = (36,000 \* (1/11.2– 1/12)) / 1000 \* 0.466

= 0.100 kW

Early replacement example: a 3 ton unit with EER rating of 12 replaces an existing unit:

ΔkW SSP (for first 6 years) = (36,000 \* (1/9.2– 1/12)) / 1000 \* 0.68

= 0.621 kW

ΔkW SSP (for next 12 years) = (36,000 \* (1/11.2– 1/12)) / 1000 \* 0.68

= 0.146 kW

ΔkW PJM (for first 6 years) = (36,000 \* (1/9.2– 1/12)) / 1000 \* 0.466

= 0.425 kW

ΔkW PJM (for next 12 years)= (36,000 \* (1/11.2– 1/12)) / 1000 \* 0.466

= 0.100 kW

**Natural Gas Savings**

N/A

**Water Impact Descriptions and Calculation**

N/A

**Deemed O&M Cost Adjustment Calculation**

N/A

**Measure Code: RS-HVC-CAC1-V05-160601**

1. The Technical Advisory Committee agreed that if the cost of repair is less than 20% of the new baseline replacement cost it can be considered early replacement. [↑](#footnote-ref-1)
2. Based upon research from “Home Energy Efficiency Rebate Program GPY2 Evaluation Report” which outlines early replacement rates for both primary and secondary central air cooling (CAC) and residential funaces. The unit (furnace or CAC unit) that initially caused the customer to contact a trade ally is defined as the “primary unit”. The furnace or CAC unit that was also replaced but did not initially prompt the customer to contact a trade ally is defined as the “secondary unit”. This evaluation used different criteria for early replacement due to the availability of data after the fact; cost of any repairs < $550 and age of unit < 20 years. Report presented to Nicor Gas Company February 27, 2014, available at http://www.ilsag.info/evaluation-documents.html. [↑](#footnote-ref-2)
3. Baseline SEER and EER should be updated when new minimum federal standards become effective. [↑](#footnote-ref-3)
4. Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007.

   [http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf](http://www.energystar.gov/ia/products/appliances/refrig/NAECA_calculation.xls)

   The "lifespan" of a central air conditioner is about 15 to 20 years (US DOE: [http://www.energysavers.gov/your\_home/space\_heating\_cooling/index.cfm/mytopic=12440](http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorRoomAirCleaner.xls)). [↑](#footnote-ref-4)
5. Assumed to be one third of effective useful life [↑](#footnote-ref-5)
6. Based on Cadmus, Opinion Dynamics; “Incremental Cost Memo\_Nov18\_2015” and assuming a 3-ton system. [↑](#footnote-ref-6)
7. Based on Cadmus, Opinion Dynamics; “Incremental Cost Memo\_Nov18\_2015” and assuming a 3-ton system. [↑](#footnote-ref-7)
8. Inferred by subtracting incremental cost from full install cost. [↑](#footnote-ref-8)
9. Based on metering of 24 homes with central AC during PY4 and PY5 in Ameren Illinois service territory. [↑](#footnote-ref-9)
10. Based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren. The average AC load over the PJM peak period (1-5pm, M-F, June through August) is divided by the maximum AC load during the year. [↑](#footnote-ref-10)
11. The two equations are provided to show how savings are determined during the initial phase of the measure (existing to efficient) and the remaining phase (new baseline to efficient). In practice, the screening tools used may either require a First Year savings (using the first equation) and then a “number of years to adjustment” and “savings adjustment” input which would be the (new base to efficient savings)/(existing to efficient savings). [↑](#footnote-ref-11)
12. Full load hours for Chicago, Moline and Rockford are provided in “Final Evaluation Report: Central Air Conditioning Efficiency Services (CACES), 2010, Navigant Consulting”, [http://ilsag.org/yahoo\_site\_admin/assets/docs/ComEd\_PY2\_CACES\_Evaluation\_Report\_2010-10-18.299122020.pdf](http://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/National%20Grid/117_RLW_CF%20Res%20RAC.pdf), p.33. An average FLH/Cooling Degree Day (from NCDC) ratio was calculated for these locations and applied to the CDD of the other locations in order to estimate FLH. There is a county mapping table in the Appendix providing the appropriate city to use for each county of Illinois. [↑](#footnote-ref-12)
13. Weighted based on number of residential occupied housing units in each zone. [↑](#footnote-ref-13)
14. Actual unit size required for multi-family building, no size assumption provided because the unit size and resulting savings can vary greatly depending on the number of units. [↑](#footnote-ref-14)
15. Based on Minimum Federal Standard; [http://www1.eere.energy.gov/buildings/appliance\_standards/residential/residential\_cac\_hp.html](http://www.ilga.gov/legislation/ilcs/ilcs5.asp). [↑](#footnote-ref-15)
16. VEIC estimate based on Department of Energy Federal Standard between 1992 and 2006. If utilities have specific evaluation results providing a more appropriate assumption for homes in a particular market or geographical area then that should be used. [↑](#footnote-ref-16)
17. The two equations are provided to show how savings are determined during the initial phase of the measure (existing to efficient) and the remaining phase (new baseline to efficient). In practice, the screening tools used may either require a First Year savings (using the first equation) and then a “number of years to adjustment” and “savings adjustment” input which would be the (new base to efficient savings)/(existing to efficient savings). [↑](#footnote-ref-17)
18. The federal Standard does not currently include an EER component. The value is approximated based on the SEER standard (13) and equals EER 11.2. To perform this calculation we are using this formula: (-0.02 \* SEER2) + (1.12 \* SEER) (from Wassmer, M. (2003). A Component-Based Model for Residential Air Conditioner and Heat Pump Energy Calculations. Masters Thesis, University of Colorado at Boulder). [↑](#footnote-ref-18)
19. Based on SEER of 10,0, using formula above to give 9.2 EER. [↑](#footnote-ref-19)
20. Based on metering of 24 homes with central AC during PY4 and PY5 in Ameren Illinois service territory. [↑](#footnote-ref-20)
21. Based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren. The average AC load over the PJM peak period (1-5pm, M-F, June through August) is divided by the maximum AC load during the year. [↑](#footnote-ref-21)