### HVAC Tune Up (Central Air Conditioning or Air Source Heat Pump)

###### Description

This measure involves the measurement of refrigerant charge levels and airflow over the central air conditioning or heat pump unit coil, correction of any problems found and post-treatment re-measurement.  Measurements must be performed with standard industry tools and the results tracked by the efficiency program.

Savings from this measure are developed using a reputable Wisconsin study. It is recommended that future evaluation be conducted in Illinois to generate a more locally appropriate characterization.

This measure was developed to be applicable to the following program types:  RF.

If applied to other program types, the measure savings should be verified.

###### Definition of Efficient Equipment

N/A

###### Definition of Baseline Equipment

This measure assumes that the existing unit being maintained is either a residential central air conditioning unit or an air source heat pump that has not been serviced for at least 3 years.

###### Deemed Lifetime of Efficient Equipment

The measure life is assumed to be 2 years[[1]](#footnote-1).

###### Deemed Measure Cost

If the implementation mechanism involves delivering and paying for the tune up service, the actual cost should be used. If however the customer is provided a rebate and the program relies on private contractors performing the work, the measure cost should be assumed to be $175[[2]](#footnote-2).

###### 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 utility peak hour)

= 68%[[3]](#footnote-3)

CFSSP = Summer System Peak Coincidence Factor for Heat Pumps (during system peak hour)

= 72%%[[4]](#footnote-4)

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

= 46.6%[[5]](#footnote-5)

Algorithm

###### Calculation of Savings

###### Electric Energy Savings

ΔkWhCentral AC  = (FLHcool \* Capacity\_cooling\* (1/SEERCAC))/1000 \* MFe

ΔkWhAir Source Heat Pump = ((FLHcool \* Capacity\_cooling \* (1/SEERASHP))/1000 \* MFe) + (FLHheat \* Capacity\_heating \* (1/HSPFASHP))/1000 \* MFe)

Where:

FLHcool = Full load cooling hours

Dependent on location as below:[[6]](#footnote-6)

|  |  |  |
| --- | --- | --- |
| **Climate Zone**  **(City based upon)** | **FLHcool**  **Single Family** | **FLHcool**  **Multifamily** |
| 1 (Rockford) | 512 | 467 |
| 2 (Chicago) | 570 | 506 |
| 3 (Springfield) | 730 | 663 |
| 4 (Belleville) | 1,035 | 940 |
| 5 (Marion) | 903 | 820 |
| Weighted Average[[7]](#footnote-7) | 629 | 564 |

Capacity\_cooling = Cooling cpacity of equipment in Btu/hr (note 1 ton = 12,000 Btu/hr)

= Actual

SEERCAC = SEER Efficiency of existing central air conditioning unit receiving maintenence

= Actual. If unknown assume 10 SEER [[8]](#footnote-8)

MFe = Maintenance energy savings factor

= 0.05[[9]](#footnote-9)

SEERASHP = SEER Efficiency of existing air source heat pump unit receiving maintenence

= Actual. If unknown assume 10 SEER [[10]](#footnote-10)

FLHheat = Full load heating hours

Dependent on location:[[11]](#footnote-11)

| **Climate Zone**  **(City based upon)** | **FLHheat** |
| --- | --- |
| 1 (Rockford) | 2208 |
| 2 (Chicago) | 2064 |
| 3 (Springfield) | 1967 |
| 4 (Belleville) | 1420 |
| 5 (Marion) | 1445 |
| Weighted Average[[12]](#footnote-12) | 1821 |

Capacity\_heating = Heating cpacity of equipment in Btu/hr (note 1 ton = 12,000 Btu/hr)

= Actual

HSPFASHP = Heating Season Performance Factor of existing air source heat pump unit receiving maintenence

= Actual. If unknown assume 6.8 HSPF [[13]](#footnote-13)

For example, maintenance of a 3-ton, SEER 10 air conditioning unit in a single family house in Springfield:

ΔkWhCAC  = (730 \* 36,000 \* (1/10))/1000 \* 0.05

= 131 kWh

For example, maintenance of a 3-ton, SEER 10, HSPF 6.8 air source heat pump unit in a single family house in Springfield:

ΔkWhASHP = ((730 \* 36,000 \* (1/10))/1000 \* 0.05) + (1967 \* 36,000 \* (1/6.8))/1000 \* 0.05)

= 652 kWh

###### Summer Coincident Peak Demand Savings

∆kW**=** Capacity\_cooling \* (1/EER)/1000 \* MFd \* CF

Where:

EER = EER Efficiency of existing unit receiving maintenance in Btu/H/Watts

= Calculate using Actual SEER

= - 0.02\*SEER2 + 1.12\*SEER [[14]](#footnote-14)

MFd = Maintenance demand savings factor

= 0.02 [[15]](#footnote-15)

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

= 68%[[16]](#footnote-16)

CFSSP = Summer System Peak Coincidence Factor for Heat Pumps (during system peak hour)

= 72%%[[17]](#footnote-17)

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

= 46.6%[[18]](#footnote-18)

For example, maintenance of 3-ton, SEER 10 (equals EER 9.2) CAC unit:

ΔkWSSP = 36,000 \* 1/(9.2)/1000 \* 0.02 \* 0.68

= 0.0532 kW

ΔkWPJM = 36,000 \* 1/(9.2)/1000 \* 0.02 \* 0.466

= 0.0365 kW

###### Natural Gas Savings

N/A

###### Water Impact Descriptions and Calculation

N/A

###### Deemed O&M Cost Adjustment Calculation

Conservatively not included.

###### Measure Code: RS-HVC-TUNE-V03-1640601

1. Based on VEIC professional judgment. [↑](#footnote-ref-1)
2. Based on personal communication with HVAC efficiency program consultant Buck Taylor or Roltay Inc., 6/21/10, who estimated the cost of tune up at $125 to $225, depending on the market and the implementation details. [↑](#footnote-ref-2)
3. Based on metering of 24 homes with central AC during PY4 and PY5 in Ameren Illinois service territory. [↑](#footnote-ref-3)
4. Based on analysis of metering results from 24 heat pumps in Ameren Illinois service territory in PY5 coincident with AIC’s 2010 system peak; ‘Impact and Process Evaluation of Ameren Illinois Company’s Residential HVAC Program (PY5)’. [↑](#footnote-ref-4)
5. 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-5)
6. Based on Full Load Hours from ENERGY Star with adjustments made in a Navigant Evaluation, other cities were scaled using those results and CDD. There is a county mapping table in the Appendix providing the appropriate city to use for each county of Illinois. [↑](#footnote-ref-6)
7. Weighted based on number of occupied residential housing units in each zone. [↑](#footnote-ref-7)
8. Use actual SEER rating where it is possible to measure or reasonably estimate. Unknown default of 10 SEER is a VEIC estimate of existing unit efficiency, based on minimum federal standard between the years of 1992 and 2006. [↑](#footnote-ref-8)
9. Energy Center of Wisconsin, May 2008; “Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research.” [↑](#footnote-ref-9)
10. Use actual SEER rating where it is possible to measure or reasonably estimate. Unknown default of 10 SEER is a VEIC estimate of existing unit efficiency, based on minimum federal standard between the years of 1992 and 2006. [↑](#footnote-ref-10)
11. Full load heating hours for heat pumps are provided for Rockford, Chicago and Springfield in the Energy Star Calculator. Estimates for the other locations were calculated based on the FLH to Heating Degree Day (from NCDC) ratio. VEIC consider Energy Star estimates to be high due to oversizing not being adequately addressed. Using average Illinois billing data (from [http://www.icc.illinois.gov/ags/consumereducation.aspx](http://www.ctsavesenergy.com/files/Final%202008%20Program%20Savings%20Document.pdf)) VEIC estimated the average gas heating load and used this to estimate the average home heating output (using 83% average gas heat efficiency). Dividing this by a typical 36,000 Btu/hr ASHP gives an estimate of average ASHP FLH\_heat of 1821 hours. We used the ratio of this value to the average of the locations using the Energy Star data (1994 hours) to scale down the Energy Star estimates. There is a county mapping table in the Appendix providing the appropriate city to use for each county of Illinois. [↑](#footnote-ref-11)
12. Weighted based on number of occupied residential housing units in each zone. [↑](#footnote-ref-12)
13. Use actual HSPF rating where it is possible to measure or reasonably estimate. Unknown default of 6.8 HSPF is a VEIC estimate based on minimum Federal Standard between 1992 and 2006. [↑](#footnote-ref-13)
14. Based on Wassmer, M. (2003). A Component-Based Model for Residential Air Conditioner and Heat Pump Energy Calculations. Masters Thesis, University of Colorado at Boulder. Note this is appropriate for single speed units only. [↑](#footnote-ref-14)
15. Based on June 2010 personal conversation with Scott Pigg, author of Energy Center of Wisconsin, May 2008; “Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research” suggesting the average WI unit system draw of 2.8kW under peak conditions, and average peak savings of 50W. [↑](#footnote-ref-15)
16. Based on metering of 24 homes with central AC during PY4 and PY5 in Ameren Illinois service territory. [↑](#footnote-ref-16)
17. Based on analysis of metering results from 24 heat pumps in Ameren Illinois service territory in PY5 coincident with AIC’s 2010 system peak; ‘Impact and Process Evaluation of Ameren Illinois Company’s Residential HVAC Program (PY5)’. [↑](#footnote-ref-17)
18. 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-18)