State of Illinois

Energy Efficiency

Technical Reference Manual

Combined Heat and Power

New Measure

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1/13/2015

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Table 1 Work Paper Revision History

#	MM/DD/YY	Author, Company	Summary of Changes
1	10/08/2014	John Cuttica, Stefano Galiasso, Shraddha Raikar, Energy Resources Center	Include new measure in the TRM
2	11/21/2014		Reflects resolved comments and open issues from 11/18/2014 SAG Meeting
3	12/5/2014		Reflects resolved comments and new comments post 12/2 SAG Meeting
4	1/7/2014		Reflects resolved issues from 12/16/2014 SAG meeting

1 Overview

The Combined Heat and Power (CHP) measure can provide electric and natural gas savings within the state of Illinois through the development and operation of CHP projects. This measure is applicable for Conventional CHP (Topping Cycle) systems as well as Waste Heat-to-Power (WHP) CHP (Bottoming Cycle) systems.

It is recognized that CHP system design and configuration may be complex, and as such the calculation of energy savings may not be reducible to the equations within this measure. In such cases a more comprehensive engineering and financial analysis may be developed that more accurately incorporates the attributes of complex CHP configurations such as variable-capacity systems, and partial combined-cycle CHP systems. Where noted, the use of values that are determined through an external engineering analysis may be substituted by agreement between the participant, the program administrator and independent evaluator.

Comment [EC1]: Added per R.Baker email on 12/5/2014

Comment [CN2]: This was in the section on measure costs, which didn't seem the right place. This seems a more relevant place.

2 New Measure Characterizations

DESCRIPTION

The Combined Heat and Power (CHP) measure can provide electric and natural gas savings within the State of Illinois through the development and operation of CHP projects. This measure is applicable for Conventional or Topping Cycle CHP systems, as well as Waste Heat-to-Power (WHP) or Bottoming Cycle CHP systems. The measure will reduce the total Btu's of energy required to meet the end use needs of the facility. Depending on the application, the saved Btu's can be converted into a combination of kWh and therms saved. In all cases estimates of the saved energy will account for any additional natural gas utilized at the site in order to operate the CHP system.

This measure was developed to be applicable to the following program types: Retrofit (RF), New Construction (NC). If applied to other program types, the measure savings should be verified.

DEFINITION OF EFFICIENT EQUIPMENT

Conventional or Topping Cycle CHP is defined as an integrated system that is located at or near the building or facility (on-site, on the customer side of the meter) that utilizes a prime mover (reciprocating engine, gas turbine, micro-turbine, fuel cell, boiler/steam turbine combination) for the purpose of generating electricity and useful thermal energy (such as steam, hot water, or chilled water) where the primary function of the facility where the CHP is located is not to generate electricity for use on the grid. An eligible system must demonstrate a minimum total system efficiency of 60% (HHV)[1] with at least 20% of the system's total useful energy output in the form of useful thermal energy on an annual basis.

Measuring and Calculating Conventional CHP Total System Efficiency:

CHP efficiency is calculated using the following equation:

$$CHP_{Efficiency}(HHV) = \frac{\left[CHP_{thermal}\ \left(\frac{kBtu}{yr}\right) + E_{CHP}\ \left(\frac{kWh}{yr}\right) * 3.412\ \left(\frac{kBtu}{kWh}\right)\right]}{F_{totalCHP}\left(\frac{kBtu}{yr}\right)}$$

Where:

$CHP_{thermal}$ = Useful annual thermal energy output from the CHP system, defined as the annual thermal energy output of the CHP system that is actually recovered and utilized in the facility/process.

[1] Higher Heating Value (HHV): refers to the heating value of the fuel and is defined as the total thermal energy available, including the heat of condensation of water vapors,resulting from complete combustion of the fuel versus the Lower Heating Value (LHV) which assumes the heat of condensation is not available

E_{CHP} = Useful annual electricity output produced by the CHP system, defined as the annual electric energy output of the CHP system that is actually utilized to replace purchased electricity requires to meet the requirements of the facility/process.

$F_{totalCHP}$ = Total annual fuel consumed by the CHP system

For further definition of the terms, please see "Calculation of Energy Savings" Section below.

Waste Heat-to-Power or Bottoming Cycle CHP is defined as an integrated system that is located at or near the building or facility (on-site, on the customer side of the meter) that does one of the following:

- Utilizes exhaust heat from an industrial/commercial process to generate electricity (except for exhaust heat from a facility whose primary purpose is the generation of electricity for use on the grid); or
- Utilizes the pressure drop in an industrial/commercial facility to generate electricity through a backpressure steam turbine where the facility normally uses a pressure reducing valve (PRV) to reduce the pressure in their facility; or
- Utilizes the pressure reduction in natural gas pipelines (located at natural gas compressor stations) before the gas is distributed through the pipeline to generate electricity, provided that the conversion of energy to electricity is achieved without using additional fossil fuels.

Since these type of systems utilize waste heat as their fuel, they do not have to meet any specific total system efficiency level (assuming they use no additional fossil fuel in their operation – if additional natural gas is used onsite, it should be properly accounted for). These systems may export power to the grid.

Comment [MS3]: If the systems export power to the grid, are they paid for it by the utility? If so, does this mean the site is paid an incentive for electricity saved and electricity sent to the grid?

Comment [ASB4]: Response: no action.

Comment [MS5]: It seems that this should also say they pay into 8-103 – i.e. a ratepayer of Ameren or ComEd (and not a muni).

Comment [ASB6]: Response: Definition of electric baseline relevant even in muni territories. If gas-only program in muni territory, still need to define baseline. Response: no action.

DEFINITION OF BASELINE EQUIPMENT

Electric Baseline: The baseline facility would be a facility that purchases its electric power from the grid.

Heating Baseline (for CHP applications that displace onsite heat): The baseline equipment would be the boiler/furnace operating onsite, or a boiler/furnace meeting the minimum standard defined in the boiler/furnace measures of the this TRM.

Cooling Baseline (for CHP applications that displace onsite cooling demands): The baseline equipment would be the chiller (or chillers) operating onsite, or a chiller (or chillers) meeting the minimum standard defined in the chiller measures of the this TRM

Facilities that use biogas or waste gas: facilities that use (but are not purchasing) biogas or waste gas that is not otherwise marketable, whether they are using biogas or waste gas only or a combination of biogas or waste gas and natural gas to meet their energy demands are also eligible for this measure. If additional natural gas is purchased to fuel the CHP system, then the additional natural gas should be taken into account in the fuel savings calculations. Consumption of any biogas or waste gas that would not otherwise being wasted (*e.g.,* flared) will be accounted for in the overall net BTU savings calculations the same as for purchased natural gas.

DEEMED LIFETIME OF EFFICIENT EQUIPMENT

Measure life is a custom assumption, dependent on the technology selected and the system installation.

Comment [MS7]: Not that it matters or should change, but this definition is moving away from an EUL, which is a population definition. From this, the estimated measure life will be site specific.

Comment [ASB8]: Response: no action.

DEEMED MEASURE COST

Custom installation and equipment cost will be used. These costs should include the cost of the equipment and the cost of installing the equipment. Equipment costs include, but are not limited to: prime mover, heat recovery system(s), exhaust gas treatment system(s), controls, and any interconnection/electrical connection costs.

The installations costs include labor and material costs such as, but not limited to: labor costs, materials such as ductwork, piping, and wiring, project and construction management, engineering costs, commissioning costs, and other fees.

Measure costs will also include the present value of expected maintenance costs over the life of the CHP system.

LOADSHAPE

Use Custom Loadshape. The loadshape should be obtained from the actual CHP operation strategy, based on the On-Peak and Off-Peak Energy definitions specified in Table 3.3 of "Section 3.5 Electrical Loadshapes" of the TRM.

COINCIDENCE FACTOR

Custom coincidence factor will be used. Actual value based on the CHP operation strategy will be used.

Algorithm

CALCULATION OF ENERGY SAVINGS

i) Conventional or Topping Cycle CHP Systems:

Step 1: (Calculating total annual source fuel savings in Btu)

The first step is to calculate the total annual source fuel savings associated with the CHP installation, in order to demonstrate that CHP applications meet the statutory definition of efficiency necessary to be included in the Illinois EEPS programs:

$S_{FuelCHP}$ = Annual fuel savings (Btu) associated with the use of a Conventional CHP system to generate the useful electricity output (kWh, converted to Btu) and useful thermal energy output (Btu) versus the use of the equivalent electricity generated and delivered by the local grid and the equivalent thermal energy provided by the onsite boiler.

$= (F_{grid} + F_{thermalCHP}) - F_{total\ CHP}$

Where

F_{grid} = Annual fuel in Btu that would have been used to generate the useful electricity output of the CHP system if that useful electricity output was provided by the local utility grid.

$= E_{CHP} * H_{grid}$

Comment [MS9]: Typically a TRC includes line losses, so any calculation after the program must be sure to not include line losses for this type of system as they are already included.

Comment [ASB10]: Response: no action. Already addressed.

Comment [MS11]: Is this source or site? Later on it appears to be site (in cost effectiveness), but here it is source.

Comment [ASB12]: Chris response: For different purposes, use different methods. For TRC screening, use changes in site use for gas and electricity, but for savings allocation different methods. Inconsistent by design. Response: no Action.

Comment [MD13]: It doesn't appear that we are accounting for offset electric chiller demand if the project includes absorption or steam-driven chillers. Should that be accounted for in this term?

Comment [ASB14]: Stefano: If you are putting in chiller, offsetting chiller. Response: Try to add factor, such as tons of cooling displaced. Phil: Just include chiller in net electric savings if chiller is present. Action: Put factor in Echp to account for systems with electric chillers.

Where

E_{CHP} = Useful annual electricity output produced by the CHP system, defined as the annual electric energy output of the CHP system that is actually utilized to replace purchased electricity required to meet the requirements of the facility/process.[2]

= ($CHP_{capacity}$ * Hours) - $E_{Parasitic}$

$CHP_{capacity}$ = CHP nameplate capacity

= Custom input

Hours = Annual operating hours of the system

= Custom input

$E_{parasitic}$ = The electricity required to operate the CHP system that would otherwise not be required by the facility/process

= Custom input

H_{grid} = Heat rate of the grid in btu/kWh, based on the average fossil heat rate for the EPA eGRID subregion and includes a factor that takes into account T&D losses.

For systems operating less than 6,500 hrs per year:

Use the Non-baseload heat rate provided by EPA eGRID for RFC West region for ComEd territory, and SERC Midwest region for Ameren territory. Also include any line losses.

For systems operating more than 6,500 hrs per year:

Use the All Fossil Average heat rate provided by EPA eGRID for RFC West region for ComEd territory, and SERC Midwest region for Ameren territory. Also include any line losses.

$F_{thermalCHP}$ = Annual fuel in Btu that would have been used on-site by a boiler or heater to provide the useful thermal energy output of the CHP system. [3]

= $CHP_{thermal}$ ÷ $Boiler_{eff}$

$CHP_{thermal}$ = Useful annual thermal energy output from the CHP system, defined as the annual thermal energy output of the CHP system that is actually recovered and utilized in the facility/process.

= Custom input

Comment [EC15]: Added per R.Baker email 12/5/2014

Comment [MD16]: Line loss factors should be provided in the TRM for Ameren and ComEd. The TRM should update them each year.

TRM should also provide the EPA eGRID subregion values for Ameren and ComEd in the TRM, or provide the link where they can be found. The latest value we currently see is Version 1.0, year 2010 data. The TRM should be updated each year with the latest value to ensure they are consistently applied.

Comment [ASB17]: Response: Add footnote with link to eGrid. Specific values will be stated for the year in which it is in effect.

Comment [EC18]: Added per R.Baker email 12/5/2014

[2] For complex systems this value may be obtained from a CHP System design/financial analysis study.

[3] Ibid

$Boiler_{eff}$ = Efficiency of the on-site boiler OR heater that is displaced by the CHP system or if unknown, the baseline value stated in the TRM for the commercial high efficiency boiler measure~~boiler measure TRM~~.

= Custom input

$F_{total\ CHP}$ = Total fuel in Btus consumed by the CHP system

= Custom input

Step 2: (Savings allocation to Program Administrators)

Savings claims are a function of the electric output of the CHP system (E_{CHP}), the used thermal output of the CHP system ($F_{thermalCHP}$), and the CHP system efficiency ($CHP_{Efficiency}HHV$). The percentages of electric output and used thermal output that can be claimed also differ slightly depending on whether the project was included in both electric and gas EEPS efficiency programs, only an electric EEPS program or only a gas EEPS program. The tables below provide the specific percentages of electric and/or thermal output that can be claimed under each of those three scenarios.

1) For systems participating in both electric EEPS and gas EEPs programs:

CHP Annual System Efficiency (HHV)	Allocated Electric Savings	Allocated Gas Savings
60%	65% of E_{CHP} (kWh)	No gas savings
>60% to 65%	65% of E_{CHP} (kWh) + one percentage point increase for every one percentage point increase in CHP system efficiency (max 70% of E_{CHP} in kWh)	No gas Savings
>65%	70% of E_{chp} (kWh)	2.5% of Fthermal (useful thermal output of the CHP system) for every one percentage point increase in CHP system efficiency above 65%.

Example: System with measured annual fuel use efficiency of 70%: Electric savings (kWh) = 70% of E_{CHP} measured over 12 months, and Gas savings (therms) = 12.5% of $F_{thermal}$ measured over 12 months (70% - 65% = 5 X 2.5% = 12.5%)

2) For systems participating in only an electric EEPS program:

CHP Annual System Efficiency (HHV)	Allocated Electric Savings	Allocated Gas Savings
60%	65% of E_{CHP} (useful electric output of CHP system in kWh)	No gas Savings
Greater than 60%	65% + one percentage point increase for every one	No gas Savings

Comment [MD19]: Should we calculate this separately for individual projects using the example given below and project-specific parameters?

Comment [ASB20]: Response: no action. This is meant to be simplification so custom calc for carbon equivalency not appropriate.

Comment [MD21]: How is this calculated? An example from a footnote gave an example for determining allocated electric savings, but we don't specify where this value comes from or provide any example.

Comment [ASB22]: Response: Provide example in footnote to demonstrate why 2.5% is the right ratio for gas.

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Comment [MD23]: This is the annual system efficiency (HHV), correct? Can we make the terminology consistent throughout to avoid confusion?

Comment [ASB24]: Response: will change terminology to make consistent.

	percentage point increase in CHP system efficiency (no max)

Example: System with measured annual fuel use efficiency of 75%: Electric savings (kWh) = 65% + 15% = 80% of E_{CHP} measured over 12 months (15% = 1% for every 1% increase in system efficiency). No gas savings (therms).

3) For systems participating in only a gas EEPS program:

CHP Annual System Efficiency (HHV)	Allocated Electric Savings	Allocated Gas Savings
60% or greater	No electric savings	2.5% of Fthermal (useful thermal output of the CHP system) for every one percentage point increase in CHP system efficiency above 60%.

Conventional or topping cycle CHP systems virtually always require an increase in the use of natural gas on-site in order to produce electricity. ~~J~~Different jurisdictions and experts across the country have employed and/or put forward a variety of approaches[4] to address~~ing~~ how increased on-site gas consumption should be reflected in the attribution of electric savings to CHP systems. ~~Those approaches range from ignoring the increased gas use (i.e. no "penalty") to roughly 40-60% "penalties", depending on the CHP efficiency, based on the number of kWh that could have been produced had the increased gas Btu's been used on the grid (a grid "Btu equivalency"). Several other approaches produce results in between those two extremes.~~ The approach reflected in the tables above is generally consistent with approaches recently put forward by the Southwest Energy Efficiency Project (SWEEP), Insitutue for Industrial Productivity (IIP) and others that determines ~~an~~reduced electric savings ~~"penalty"~~ based on the equivalent amount of carbon dioxide generated from the increased gas use. The following example describes this approach:

1. Given data for an example CHP project:~~which essentially establish an electric savings "penalty" that is equal to the amount of~~
   a. Produces 5 million kWh annually
   b. Reduces on-site gas use for space heating by 26 million kBtu annually
   c. Consumes 50 million kBtu of gas annually to generate the electricity and waste heat
   d. Total annual CHP efficiency is 70.6% HHV
2. Calculating gas increase and determing subsequent carbon increase
   a. Net increase in on-site gas use is 24 million kBtu (i.e., 50 million kBtu – 26 million kBtu)
   b. Carbon dioxide emission rate for natural gas combustion is 53.06 kg/MMBtu based on xxx
   c. Increase in carbon dioxide emissions from natural gas for this project is 1,273,440 kg (i.e.,

[4] Approaches range from ignoring the increased gas use entirely (i.e., no "penalty") to applying approximately 40-60% "penalties", depending on the CHP efficiency and based on the equivalent grid kWh that the increased gas use represents.

Comment [MS25]: It seems we should have an example here too as later on it seems they we are using 60% as the base, not 65%, so should be sure that it is clear in the example.

Comment [ASB26]: Response: 60%, not 65%. Stefano will provide example.

Comment [ASB27]: Response: Put in footnote add reference if possible.

Comment [MD28]: Add a footnote describing who represents "others" or remove.

Comment [ASB29]: Response: remove reference to "others". There was a third one but can't recall at this time.

Comment [MS30]: There are several clarifications that seem to be needed in this section:
1) What are the citations for the values used like the emission factors?
2) It appears that you have included this carbon based approach within the tables above (i.e., I think that is how you got to the 65% Echp value for allocating savings). Is this true? If so, this needs to be said explicitly and the example shown only for how the 65% value was derived. I don't know if there is an expectation that this value is calculated for each project, but it doesn't seem to be.
3) The move to a carbon based calculation for fuel switching will support regional carbon reductions. This is a goal that I can support as a reduction in carbon gases is good for the environment. However, I am uncertain whether using carbon based fuel switching calculations moves away from implicit or explicit goals for the ratepayer funds for electricity and gas. To me, this is a policy choice and not an evaluator choice. Absent any better argument, I support any fuel switching that could occur with any energy efficiency measure use the same approach, what ever that choice is.

Comment [ASB31]: Response #1: will provide references for emissions factors, etc.. Response #2: sticking with generic tables. Response #3: evaluator comment, no action. ADD: The following example used to develop proxy values in Tables 1, 2, 3. Keep This is not an example of how you would apply TRM, demonstration of carbon equivalency method and how produces results that are consistent with tables. In other words, demonatration of approach used in Tables 1, 2, 3. Keep as footnote.

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Comment [MD32]: Recommend including all the emission factors in the TRM for consistency

Comment [ASB33]: Response: already addressed. Will provide references. ADD: Emission rate and heat rate assumptions in Appendix to TRM for Ver. 5.0.

24,000 MMBtu * 53.06 kg/MMBtu)

d. Converting kg to tons results in an emissions increase from gas of 1,404 tons carbon dioxide per year

3. Calculating reduction in electrical savings

a. Assume an emission rate of 1.098 tons of carbon dioxide per MWh for Illinois to determine equivalent electricity from the gas emissions

b. Grid production equivalent is 1,279 MWh (i.e., 1,404 tons per year / 1.098 tons/MWh) or 1.28 million kWh.

~~1.~~ The electric savings penalty for this example project would therefore be approximately 25.6% (i.e., 1.28 million kWh / 5 million kWh).

c. The allocated electric savings in the table above are calculated by subtracting the calculated electric penalty from 100% (i.e., 100% - 25.6% = 74.4%). This allocated percentage is then multiplied by the annual electricity production, to determine the claimed savings.

~~2.~~

~~3. kWh that could be produced by the electric grid with a "carbon emissions budget" that is equal to the emissions associated with the increased on-site gas consumption. The result of this "carbon equivalency" approach is a savings penalty that will typically range from 20% to 35%.[5] That result is also solidly in the middle of the two extremes discussed above.~~

There are also a variety of ways one could treat the potential for gas utilities to claim savings from CHP projects in their EEPS portfolios. For projects in which a gas utility EEPS program is involved, the tables above treat savings from CHP installations in two steps: (1) a fuel-switch from electricity to gas (i.e. using more gas to eliminate the need to generate as much electricity on the grid); and (2) possible increases in CHP efficiency above a "benchmark" level. When both electric EEPS and gas EEPS programs are involved in a project, the electric utility claims all the savings associated with a fuel-switch up to a "benchmark" 65% efficient CHP system. The gas utility then claims all the savings associated with increasing CHP efficiencies above that benchmark level (e.g. if the CHP efficiency is 75%, the gas utility claims the gas savings associated with an increase in CHP efficiency from 65% to 75%). That is consistent with the notion that CHP efficiency typically increases primarily by increasing use of the thermal ouput of the system (increasing the displacement of baseline gas use). For projects that involve only a gas utility EEPS program, the "benchmark" above which the gas utility can claim savings is lowered to 60%.

ii) **Waste-Heat-to-Power CHP Systems :**

ELECTRIC ENERGY SAVINGS:

$$\Delta kWh = E_{CHP}$$

Where

[5] ~~Consider, for example, a hypothetical CHP system that produces 5 million kWh annually, consumes 50 million kBtu of gas annual to generate that electricity (i.e. electric efficiency of approximately 34.8% HHV), reduces on-site gas use for space heating by 26 million kBtu of gas (i.e. equivalent to approximately 81.5% CHP thermal output utilization displacing gas used in a 70% efficient space heating boiler) and has a total annual CHP efficiency of 70.6% HHV. In this example, the net increase in on-site gas use is 24 million kBtu. At a carbon dioxide emission rate of 53.06 kg/MMBtu for burning natural gas, that translates to an increase in on-site carbon dioxide emissions of 1404 tons per year. At an estimated marginal emission rate of 1.098 tons of carbon dioxide per MWh in Illinois, that is equivalent to electric grid production of approximately 1.28 million kWh, or penalty of about 25.6% of the CHP system's electrical output.~~

Comment [MD34]: Where does this number come from? (it was originally in a footnote)

Comment [ASB35]: Response: Reference properly.

Comment [MD36]: Recommend including emission factors in TRM so they are applied consistently. Recommend separate factors for Ameren and ComEd and ensuring that they are updated annually.

Comment [ASB37]: Response: Will do in ver. 5.0, as well as MS 38. Will put in Appendices in back so same values are used for other measures if they need the values.

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Comment [MS38]: How does this fit into the set values in the tables?

Comment [ASB39]: No response.

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Comment [MS40]: This seems like a simple replacement of grid kWh by site kWh and no line losses are included here. Is this correct? If so, then the TRC needs to be different based on type of CHP.

Comment [ASB41]: Response: no action. Values may be different but high-level terms will be the same, so the TRC calculation is not in fact different.

E_{CHP} = Useful annual electricity output produced by the CHP system, defined as the annual electric energy output of the CHP system that is actually utilized to replace purchased electricity required to meet the requirements of the facility/process.

= Custom input

NATURAL GAS ENERGY SAVINGS:

$$\Delta Therms = F_{thermalCHP} \div 100{,}000$$

Where

$F_{thermalCHP}$ = Net savings in annual purchased fuel in Btu, if any, that would have been used on-site by a boiler or heater to provide some or all of the useful thermal energy output of the CHP system[6].

100,000 = Conversion factor for Btu/hr to therms

SUMMER COINCIDENT PEAK DEMAND SAVINGS

$$\Delta kW = CF * CHP_{capacity}$$

Where

CF = Summer Coincidence factor. This factor should also consider any displaced c~~C~~hiller capacity[7]

= Custom input

$CHP_{Capacity}$ = CHP nameplate capacity

= Custom input

WATER IMPACT DESCRIPTIONS AND CALCULATION

N/A

DEEMED O&M COST ADJUSTMENT CALCULATION

Custom leveled Maintenance costs that will be incurred for the life of the measure will be used. Maintenance costs vary with type and size of the prime mover. These costs include, but are not limited to:

- Maintenance labor
- Engine parts and materials such as oil filters, air filters, spark plugs, gaskets, valves, piston rings, electronic components, etc. and consumables such as oil
- Minor and major overhauls

Comment [MS42]: What are "leveled" maintenance costs? Also, are these "net" O&M? that is, difference between O&M for previous system and O&M for CHP system? Or is this just for the CHP?

Comment [ASB43]: Response: Term should be "levelized." Leveled is a typo. Whatever are lifetime O&M should be included in value. Must include net O&M above baseline. What additional O&M does CHP introduce? Must include these costs. Response: remove "levelized". Replace with "Custom estimates of maintenance costs".

[6] In most cases, it is expected that waste to energy systems will not provide any new net useful thermal energy output, since the CHP system will be driven by thermal energy that was otherwise being wasted. If additional natural gas or other purchased energy is used onsite, it should be properly accounted for.

[7] ~~If additional natural gas is used onsite, it should be properly accounted for.~~If some or all of existing electric chiller peak demand is no longer needed due to new waste heat powered chillers (e.g., absorption), the coincidence factor should be adjusted appropriately.

For screening purposes, the US EPA has published resource guides that provide average maintenance costs based on CHP technology and system size[8].

COST-EFFECTIVENESS SCREENING

For the purposes of screening a CHP measure application for cost-effectiveness, changes in site energy use – reduced consumption of utility provided electricity and the net change in consumption of natural gas – should be used. Where

Benefits: $E_{CHP} + \Delta kW + F_{thermal\_CHP}$

Costs: $F_{total\_CHP} + CHP_{COSTS} + O\&M_{COSTS}$

CHP_{Costs} = CHP equipment and installation costs as defined in the "Deemed Measure Costs" section

$O\&M_{Costs}$ = CHP operations and maintenance costs as defined in the "Deemed O&M Cost Adjustment Calculation" section

3 Proposed Changes to Existing Measures

N/A

[8] "EPA Combined Heat and Power Partnership Resources" Oct 07, 2014, http://www.epa.gov/chp/resources.html

Comment [MS44]: Can you provide a better footnote here as I couldn't find this specific document on the site. There were several and I looked at what seemed logical to me, but none were labled to have O&M costs.

Comment [ASB45]: Response: will add page number.

Comment [MS46]: This says source for Step 1 of conventional CHP – which is it?

Comment [ASB47]: No action. For different purposes using different things.

Comment [CN48]: NRDC/DCEO edited this language to be clearer and simpler (hopefully!)

Comment [SG49]: I think we can use the previously defined Delta(kW)= CF * CHP_capacity OR we could use a definition with hours of use, such as Delta(kW)=CF/Hours*E_CHP. The two could be different depending on how the system is operated. Also, it doesn't include Chiller offset kW / kWh --- wouldn't those be savings too?

Comment [ASB50]: Electric chiller is already added to ECHP. Response: No action.

Comment [EC51]: Regarding part one – kw definition - SAG to discuss and decide – both are technical correct

Comment [ASB52]: Response: no action.

Comment [EC53]: Regarding part 2- chiller offset, the only time you need to add the chiller benefit is when you have added a new absorption chiller . If you keep electric chillers, you catch the savings in the existing kw calc, if you displace the thermal generation for an existing absorbption chiller you catch the savings in the Fthermal. If you add a brand new absorption chiller that you did not have before and retire the existing electric chiller and you use all the CHP electric out put as well, than, the kw savings would be: TONS * ((IPLVbase) – (IPLVee)) * EFLH wher eIPLVbase would be the displaced electric chiller and IPLVee would be the new absorption chiller. (this is from the commerical chillller TRM).

Comment [ASB54]: Response: no action.

Comment [EC55]: There are already listed above (page 10 so not needed here)

Comment [ASB56]: Response: no action. We deleted information that comment was based on.

4 References

Please refer to the Chicago style for variances on format citations. Please upload any new references or calculation sheets to the Tracker item.

http://www.chicagomanualofstyle.org/tools_citationguide.html

EXAMPLES:

Paper presented at a meeting or conference (Including internal work papers)

Author Name, "Paper title" (paper presented at the annual meeting for the Organization Name, City, State, Month Day, Year).

Website

"Title," last modified Month Day, Year, URL

E-mail

Author Name, e-mail message to author, Month Day, Year.

Item in a commercial database

Author Name. "Source Title" Publisher, Year. Database Name

Book: Chapter or other part of a book

Author Name, "Chapter," in Title, City: Publisher, Year, page range

Book: Published electronically

Author Name, "Chapter," in Title, City: Publisher, Year, Accessed Month Day, Year. URL.

Journal Article in a print journal (Use this for program evaluations.)

Author Name, "Article Title," Journal Name edition (Year): page

Author Name, "Evaluation Title," Utility Name, Program or Measure Name (Date): page

Journal Article in an online journal

Author Name, "Article Title," Journal Name edition (Year): page, accessed Month Day, Year, dio:xx.xxxx/xxxxxx.

5 Stakeholder Comments

If adding comments to an existing work paper, add note in "Progress Notes" section of the tracker item stating *"(Author, Company) added comments to workpaper, (date)*". This will send an alert to VEIC and others that a new comment has been added.

Stakeholder Comments to Revision 1Author, Company and Date: Philip Mosenthal, Optimal Energy on behalf of the Eric Robertson and Ali Al-Jabir, Illinois Attorney General's Office, 10/30/Industrial Energy Consumers (IIEC), October 24, 2014.

Comment:

See above redline and comments.

General Comment: The AG continues to oppose crediting a utility with savings that count toward meeting goals if the actual utility system sales will increase. We agree generally with the math, the issue is really one of allocation.

Also, we believe that some circumstances are not fully or properly covered regarding when either the thermal output is offsetting a different fuel than Natural Gas or the CHP system is fired by a different fuel. It appears even if a CHP system was oil fired and offsetting oil thermal load that the above proposal would still provide savings credit to the gas utility. We acknowledge with today's economics we may not see any oil fired systems, but it is possible and should be addressed.

IIEC's revisions to Section 2 of the proposed CHP measure are designed to recognize that large industrial customers are sophisticated users of electricity who possess the economic incentive, resources and expertise to adequately assess and analyze CHP opportunities at their sites. While the use of generic inputs and the formulas specified in the proposed CHP measure may be appropriate for smaller customers, such inputs and formulas may not be appropriate for large customer facilities with peak loads of 3 MW or more at an individual site or peak loads of 5 MW or more at the aggregate company level within a utility's service territory. Such large customers should be afforded maximum flexibility to customize all of the measure formulas and the variable inputs that are used to evaluate CHP opportunities at their sites, as long as the customers can adequately document the engineering studies and cost-benefit analyses conducted to justify the implementation of a CHP project at their sites.

Large industrial customers operate in very competitive business environments and are actively pursuing energy savings opportunities where such opportunities are cost-effective. As a matter of good business practice, such customers will not pursue a CHP project unless it is thoroughly analyzed through engineering and cost-benefit studies and unless the project can clear the internal return on investment hurdles that the customer has established within its company. Consequently, the requirement of using a more rigid, formulaic approach to the evaluation of CHP projects for such customers, as set forth in the proposed CHP measure, is inappropriate, unnecessary and may inhibit the implementation of many cost-effective CHP projects.

IIEC's other revision to Section 2 is to include within the scope of the CHP measure generation from process gases that may not otherwise fit into the category of "biogas," but similarly constitute lower BTU content gas that otherwise has no marketable value and may be disposed of onsite, i.e. flared.

Also, the CHP measure should provide examples of the application of the proposed efficiency algorithm to prime movers to provide TRM users with a better understanding of the algorithm and to provide a means of testing the algorithm.

Stakeholder Comments to Revision 2

Stakeholder Comments to Revision 2

Authors: Eric Robertson and Ali Al-Jabir on behalf of the Illinois Industrial Energy Consumers (IIEC)

IIEC has modified its previously submitted comments regarding the applicability of the CHP measure to clarify that IIEC is not requesting a blanket exemption from all aspects of the CHP workpaper for large customers. Rather, IIEC simply seeks to clarify that large customers should be able to substantiate the costs and energy savings associated with their CHP projects using the data and analysis they prepare in-house, with the understanding that this data and analysis would be subject to review by the local electric or natural gas utility for sufficiency. The purpose of IIEC's proposed language is to ensure that large customers will not be required to prepare two separate sets of analyses to support a CHP project (one analysis to meet the customer's internal corporate requirements and a separate analysis to conform to the requirements of the CHP workpaper). IIEC's suggested approach would be equivalent to approval of a customized measurement for an energy efficiency measure. IIEC's revised proposed language can be found under the heading "Deemed Measure Cost."

Comment [CN57]: Note that DCEO/NRDC have moved this to the intro section instead, as this wasn't really a measure cost issue.