White Paper

Implementing the Combined Heat and Power and Waste Energy Recovery Provisions of Revised Code Sections 4928.64 & 4928.66

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Background

In June 2012, Ohio Governor John Kasich signed into law Ohio Senate Bill 315. The law allows Waste Energy Recovery (WER) projects to qualify as a renewable energy resource under Ohio's Renewable Portfolio Standard (RPS). or as an energy efficiency measure under Ohio's Energy Efficiency Resource Standard (EERS). The law also allows efficient Combined Heat and Power (CHP) and WER projects to be considered an eligible energy efficiency program under the EERS, with savings to be estimated by the Commission.

CHP and WER Rules Will Heavily Influence Technology Deployment

Ohio's experience with Combined Heat and Power (CHP) and Waste Energy Recovery (WER) will be heavily influenced by the rules the Public Utilities Commission of Ohio (PUCO) issues to implement Senate Bill 315. California designed its CHP incentives to encourage electric peak demand reduction: the resulting installations, often poorly matched to the thermal energy needs of the business, were not adequately maintained over time and performed poorly[1]. Massachusetts' CHP incentives, on the other hand, encourage developers to design a system and its operation strategy to meet the thermal needs of the business, yielding much better overall CHP system performance[2]. As the Commission develops rules to implement the CHP and WER provisions of Senate Bill 315, it must make four critical decisions:

1. What are the goals of Ohio's CHP and WER programs?
2. How will savings from a CHP or WER system be estimated?
3. How should project developers receive incentives for CHP or WER installations?
4. How should electric utilities be credited for CHP installations that they support?

In consultation with Bruce Hedman, Former Vice President for ICF International and John Cuttica, Director of the Energy Resources Center at the University of Illinois at Chicago, we developed and are recommending an approach to the above decisions that will help ensure the economic and environmentally-beneficial development of CHP and WER in Ohio.

[1] The annual mean outage factor (the average portion of days in a year that will be within an outage lasting 30 days or more) after 5 years was 50% for systems with internal combustion engines as the prime mover, 40% for microturbines and fuel cells, and 25% for gas turbines. See Itron, CPUC Self-Generation Incentive Program Tenth- Year Impact Evaluation Final Report, July 7, 2011, ES-9, available at: http://www.cpuc.ca.gov/PUC/energy/DistGen/sgip/

[2] 2010 Combined Heat and Power Impact Evaluation Methodology and Analysis Memo, Kema, Itron, and ERS, January 11, 2012, at 1-5, available at: http://www.maeeac.org/docs/2011%20to%202012%20EMV/Non- Residential/Study%2019_CHP%20Impact%20Eval%20Memo_FINAL.pdf.

Defining CHP and WER Systems

A CHP system consists of a prime mover and generator that produces electricity (i.e., reciprocating engine, gas turbine, micro-turbine, fuel cell), and a heat recovery system that uses the waste heat from that prime mover to generate useful thermal energy, like steam, hot water, or chilled water. The performance of CHP systems depends on several factors:

- Facility selection (i.e., the unique thermal and electrical needs of the site, from hour-to-hour and over a year)
- CHP system design (i.e., generator size)
- System operation strategy (electric load following, thermal load following)
- System age
- System maintenance and outages
- Composition, temperature and pressure of the waste heat

A WER system consists of a heat recovery system that uses the exhaust or wasted heat from an industrial process (such as steel production, refining, glass productions, etc) to generate electricity. The performance of WER systems depends on several factors:

- Facility selection (i.e., the amount and consistency of waste heat produced, the electrical needs of the site, and the opportunity to sell excess electricity to another party)
- WER system design
- The operational characteristics of waste heat producers
- System maintenance and outages

Developing WER Projects under the RPS

1. *What are the goals of Ohio's WER program under the RPS?*

Given that WER systems are now qualify as a renewable energy resource in the state RPS, it is appropriate for the Commission to establish the goals of Ohio's renewable WER program as encouraging emission-free power generated from readily available on-site resources and promoting innovation and market access for cost-effective WER technologies.

2. *How should WER projects be incorporated into Ohio's RPS?*

Developing WER projects under the state RPS should essentially mirror the same process as other qualified renewable resources. As such, the amount of Renewable Energy Credits (RECs) certified for a WER system should be equal to the portion of its electricity production that comes from waste energy or waste fuel. The energy produced by supplemental fuel should not be considered "renewable" and therefore not factored into the Megawatt hours that are certified as a REC.

Developing CHP and WER Projects under Ohio's EERS

1. *What are the goals of Ohio's CHP and WER Program under the EERS?*

Establishing a goal for the Commission's CHP and WER program will help guide the Commission's decisions and send a useful signal to project developers and utilities. Given that CHP is included as an "energy efficiency program" in Revised Code Section 4928.66, it is appropriate for the Commission to establish the goals of Ohio's CHP and WER program as saving energy, reducing greenhouse gas emissions, and promoting innovation and market access for cost-effective CHP and WER technologies.

2. *How will savings from a CHP and WER system be estimated?*

Savings from a WER system used to comply with the EERS (instead of the RPS) should be measured using the same methodology we recommend be used to determine the number of RECs that would have been generated by the system had it been used to comply with the RPS (total system output minus system output from non-waste fuel).

Savings from a CHP system should be measured using an approach that encourages the most efficient design, installation and operation of the system. At the same time it should be simple to implement and not overestimate or underestimate the electric savings. The approach recommended in this paper is a **Threshold/Tiered Approach**. As designated in the law[3], only CHP installations that are projected to exceed the 60% efficiency (LHV) threshold will be considered qualified energy efficiency measures. The Threshold/Tiered Approach recommends that the portion of the electricity produced by a CHP system (MWh) allowed as qualified savings to increase as the efficiency of the CHP system (measured in Lower Heating Value or LHV) increases according to the table below:

Efficiency Thresholds & Corresponding Megawatt Hours Considered Savings

Tier Level	Overall CHP System efficiency – Lower Heating Value (LHV)	Portion of MWh output considered savings
	< 60%	0%
Tier 1	60% - 65%	60%
Tier 2	65% - 70%	70%
Tier 3	70% - 74%	80%
Tier 4	74% - 77.5%	90%
Tier 5	> 77.5%	100%

This approach has multiple advantages, as it:

- incentivizes all prime mover technologies and does not pick technology winners
- encourages project developers to design higher-efficiency installations, regardless of the prime mover technology
- is based on the performance of real CHP systems, of various sizes, configurations and technologies
- is simple to administer and implement, as it requires only a simple calculation of overall system efficiency based on readily available inputs (and minimizes issues surrounding heat-rates) neither underestimates nor overestimates savings.

In developing our recommended approach, we reviewed and studied three available approaches: Southwest Energy Efficiency Project (SWEEP) approach which we felt was most accurate but would be difficult to implement; the Massachusetts approach that we felt could result in overestimating CHP savings; and the American Council for an Energy Efficient Economy (ACEEE) approach that we felt could result in underestimating the CHP savings.

3. *How should project developers receive utility incentives for CHP and WER systems?*

CHP Project developers should be paid according to the actual performance of each system, rather than projected performance, because the actual efficiency of a CHP system is highly variable and dependent on various factors (as described in the CHP System section above). The utility should pay a CHP project developer a portion of the incentive upon system commissioning (recommend 60%), based on the projected efficiency and savings for the first year of operation using the threshold-tiered method. The balance of the incentive (recommend 40%) would be awarded one year after commissioning based on actual efficiency and savings

[3] R.C. 4928.01(A)(40) and R.C. 4928.66(A)(1)(a)

trued-up so that the total incentive reflects one year of actual operation. The incentive-per-saved-MWh provided by the utility should not be mandated by the Commission, but should in total not exceed 50% of total project cost.

WER project developers should be paid according to the actual performance (i.e., output) of each system. The utility should pay the project developer a portion of the incentive upon system commissioning (recommend 60%), based on nameplate capacity for the first year of operation. The balance of the incentive (recommend 40%) would be awarded one year after commissioning based on actual output trued-up so that the total incentive reflects one year of actual operation.

4. *How should electric utilities be credited for CHP and WER installations that they support?*
Electric utilities should receive credit toward their energy efficiency obligations based on the same schedule they pay out incentives, using the Threshold/Tiered Approach (for CHP and WER Systems):

- 60% in the year of commissioning based on expected performance over the next 12 months
- 40% in the year ending 12 months after the commissioning of the system, trued-up for actual performance during that period.

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5. Example CHP Projects

The following chart provides four example projects and how the recommended Threshold/Tiered Approach would be applied to calculate the allowable energy savings. The first three examples were chosen to demonstrate how the approach is technology neutral, and the fourth example shows how the approach encourages designing for high efficiency (maximum thermal utilization of the CHP waste heat).

Equipment and Operating Data	Example 1 – Micro-turbine	Example 2 - Recip. Engine	Example 3 – Gas Turbine	Example 4 – Gas Turbine
Capacity, kW	60	800	5,400	5,400
Operating Hours/year	6,000	6,000	6,000	6,000
CHP Electric Gen/yr., MWh/yr	360	4,800	32,400	32,400
Thermal Utilization of CHP Waste	77%	77%	77%	95%
Avail Waste Heat MMBtu/hr	0.36	3.44	27.81	27.81
CHP Thermal Utilized MMBtu/yr	1,663	15,893	128,482	158,517
Total Fuel Use (CHP) MMBtu/hr	0.83	7.80	64.88	64.88
Total CHP Efficiency (LHV)	64%	76.2%	67.9%	76.4%

Allowable Energy Savings (utilizing Threshold-Tier Approach)

	Example 1 – Micro-turbine	Example 2 - Recip. Engine	Example 3 – Gas Turbine	Example 4 – Gas Turbine
Applicable Tier	64% = Tier 1	76.2% = Tier 4	67.9% = Tier 2	76.4% = Tier 4
Allowable Savings (% of MWh Generated)	60%	90%	70%	90%
Total MWh Generated	360	4,800	32,400	32,400
Allowable Savings (MWh) At Commissioning (60%) End of 12 months operation (40%) Total Allowable Savings	 130 86 216	 2,592 1,728 4,320	 13,608 9,072 22,680	 17,496 11,664 29,160

Typical Applications (not all inclusive – simply examples):

- Micro-turbines: multifamily, nursing homes, waste water treatment facilities, small commercial
- Recip. Engine: food processing, office buildings, multifamily, hospitals, schools, small manufacturing
- Gas Turbine: hospitals, universities, chemical plants, refineries, food processing, paper, heavy industries

6. Conclusion

We appreciate this opportunity to comment on the implementation of Senate Bill 315. We urge the Commission to adopt a uniform approach to the calculation of savings from CHP and WER systems, the application of savings to a utility's energy efficiency benchmarks, and the payment of utility incentives for CHP and WER projects. A uniform approach will provide market certainty to CHP and WER project developers and host sites. We also respectfully ask the Commission to prioritize the issuing of rules to implement the CHP and WER provisions of Senate Bill 315. Without a regulatory and incentive structure, project development cannot proceed. Please contact Dylan Sullivan or Trish Demeter with any questions.