Commentary On Electric and Natural Gas Committee Workshop: Combined Heat and Power Guidelines

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In response to the workshop discussions and presentations, I offer the following for the consideration by the California Energy Commission's Electricity and Natural Gas Committee in their development of CHP Technical Guidelines for the implementation of AB 1613 mandates.

1. Much commentary and discussion about the use of bottoming cycles on facilities that have otherwise wasted energy streams (particularly the cement industry represented at the meeting). Seemingly a consensus was reached that the addition of bottoming cycle plants to existing facilities would be "exempt" from the proposed guidelines for implementation of AB1613 because "we are capturing wasted energy and making electric power that would otherwise be lost." While admirable and seemingly appropriate, the same logic could be applied to any DG/CHP retrofit application. For instance, an existing gas turbine engine generator, it could be argued, would be exempt from the guidelines if a bottoming cycle and/or waste heat recovery heat exchanger to generate hot water/steam were added for the same logic – capturing waste heat the would otherwise be wasted. Alternately suppose a process that requires steam is retrofitted with a pressure reduction turbine rather than a throttle valve; electric energy is generated where energy was previously wasted; the same logic could be argued to exempt this installation. Exempting some existing facilities from guidelines when retrofitted to capitalize upon the AB1613 intentions becomes a "slippery slope" defining where the limits of the exemption are. **Recommendation:** do not exempt any facilities (new or existing with proposed retrofits), from guidelines.
2. Belief that the efficiency of the overall system should be based upon lower heating value of the fuel. This is in contrast to the general consensus that a 60% based upon HHV would be appropriate. Use of the lower heating value is more meaningful from an engineering perspective in that it is more realistically defines the actual operation of a system (water is rarely allowed to condense out in the exhaust) and is less composition fuel dependent. **Recommendation:** Threshold

criteria for system efficiency should be based upon LHV. Suggest a threshold of 65% LHV

Relative to Art Soinski's presentation:

3. Slide 13: Useful thermal output is defined as gross thermal output minus thermal input. The term "useful" strongly implies (defines) the thermal output as the end product (such as hot water/steam) rather than changes in the exhaust stream enthalpy. This definition also works well for thermally activated cooling (e.g. absorption chillers) where the cooling is easy to define. A circumstance that does not potentially fit as well is an absorption chiller utilizing water or steam; is the useful heat the hot water/steam from the heat exchanger that feeds into the chiller or the actual chilled water output from the absorption chiller? Both energy streams could be considered useful energy. However, the chilled water, being the output should be consider the useful output; also, consideration of the chilled water output provides benefit and incentive for end users to install double effect absorption chillers if the heat/temperature is sufficient (note that this is not the case with current AB1298 calculations for emissions compliance). **Recommendation:** define the useful thermal output and system boundary as the interface point for the final useful fluid rather than at a point of initial heat recovery (e.g. output of the chiller rather than the waste heat recovery generator).
4. Slide 13; Relative to the same subject, thermal output should be clarified as enthalpy rather than thermal. The latter suggests temperature based measurements which is not applicable if the thermal output is steam. **Recommendation:** Useful thermal output should be based upon change in enthalpy of the working fluid.
5. Slide 15, comment is made relative to a 60% efficient chiller (actually from TIAX report). This is not a conventional nor even meaningful measure of chiller performance. Chillers move heat energy and as such almost always have efficiencies, when defined by energy out / energy in greater than 100%. For refrigeration cycles the energy out (or more accurately, the energy moved) / energy is defined as the coefficient of performance or COP. Typical chillers (make cold water) have COP of 2-3 with state of the art systems advanced units having COP of 4. Air conditioners, COP of 4 is typical for standard package units and can be as high as 5. **Recommendation:** two level of criteria be established depending upon application:
    a. For hydronic chilling, use a COP = 3
    b. For HVAC direct expansion units, use a COP = 4.
6. On same slide (slide 15), the definition of CHP emissions seems inconsistent. For an emissions factor based upon fuel consumption, the equation would be correct and is typical of emission factor calculations. However, further on the page and throughout the document, an emissions factor or 1,100 lb/MWh is used. The units on this constant are consistent with a generation based emissions factor, an appropriate methodology that rewards generator efficiency, but is inconsistent with the basic formula outlined on the slide. **Recommendation:** In calculating the CO2 emissions, careful use of the 1,100 lb/MWh is critical to insure that it is consistent.

7. For the Documentation/Verification a program similar to SCAQMD 1110.2 could be employed for facilities that are and are not in compliance. Demonstrated compliance would allow less stringent reporting/verification (maybe quarterly) while non-compliance would require monthly reporting. **<u>Recommendation:</u>** Provide facilities that demonstrate compliance less stringent reporting criterion.
8. Any consideration of demonstrated annual availability/operation must consider the financial benefits available to customer. While seeming self evident, it is critical that any measure of availability must consider whether it makes economic sense for the operation of the system given local electric tariffs, feed in tariff rates, and fuel costs. **<u>Recommendation:</u>** FiT does not need to make DG/CHP operation beneficial 24/7; however, any requirements for specific # hours of operation and/or percentage of operation for a year must consider the availability of the system relative to operation being economically beneficial to the implementer.
9. What, if any, consideration is made for the use of opportunity fuels (landfill gas, digester gas, well head gas)? Truly a case for making use of otherwise wasted resource. Carbon credits for displacing power plant emissions at rate of 1100 lb/MWh? **<u>Recommendation:</u>** Consider the use of opportunity fuels more favorably than the use of natural gas. Do not have any specific advice as to the specific favorable nature.

In the presentation by Keith Davidson relative to the Oregon model for assessing application and financial compensation/incentives for system:

10. Overall interesting concept and generally agree with approach promoted.
11. Does not provide for considerations where DG/CHP would be used in place of non-boiler based/generated heat needs (e.g. direct hot air generation for drying process or an application of DG/CHP absorption chilling that would displace electric powered chiller/HVAC, not a boiler).
12. The concept of 100% waste heat utilization presented in many locations throughout in the presentation is vague. Thermodynamically, it is not possible to recover 100% of waste heat from the prime generator, whether that is the overall waste heat or the heat available in the exhaust. In practice, the exhaust temperature exiting any waste heat recovery device must be kept at sufficiently high temperature to prevent exhaust moisture condensation and provide enough temperature for exhaust plume loft and dispersion (the former can be mitigated with a condensing boiler/heat exchanger but these are rare and expensive and generally not applied). For typical microturbine applications, practical waste heat recovery is approximately 75% of the available heat in the exhaust, with a final exhaust temp of between 250F and 300F. The proposed guidelines pro-offered by the CEC staff does not include the concept of level of waste heat utilization. This comment is more directed towards information and clarification should the concept of degree of waste heat utilization. All standards should be based upon the useful end product as defined by the staff proposed guidelines (amended as defined above).