

AB 1613 CEC Workshop

April 13, 2009

Eric Wong, Cummins Inc.
California Clean DG Coalition

DOCKET

08-WHCE-1

DATE April 13 2009

RECD. April 14 2009





TOPICS

- Recent CHP Report
 - One Finding: 66 % HHV average efficiency
 - *Combined Heat and Power, Effective Energy Solutions for a Sustainable Future*, ORNL, December 1, 2008; ORNL/TM-2008-224
- LHV vs HHV
- SHP and CHP
 - Massachusetts investigation



ORNL REPORT- DATABASE

- ICF maintains a database of CHP installations for the U.S. DOE through a contract with ORNL – www.eea-inc.com
- The database includes over 3300 sites representing over 85,000 MW of CHP capacity – CHP is broadly defined including within the fence systems owned by the facility, IPP systems selling thermal energy to an adjacent steam host, and waste heat power systems.
 - The database is meant to be comprehensive – coverage of systems > 1 MW is thought to be >98%; coverage of smaller systems is most likely > 80%



ORNL REPORT- DATABASE (con't)

- Based on this analysis, overall CHP fleet performance in 2006 is estimated to be:

| | |
|--------------------------------|---------------------------|
| – Net power generation: | 505,949 GWh |
| – Thermal energy provided: | 3,776 TBtu |
| – Average CHP efficiency: | 66.3 % (HHV) |
| – Average CHP system P/H ratio | 0.5 |
| – Total CO2 savings: | 248 million metric tones* |

(*based on avoiding national average fossil fuel generation emissions of 1,879 lb CO2/MWh, 9% average T&D losses, and 75 to 83 % onsite boiler efficiency depending on fuel type)



LHV vs. HHV Must Always be Designated by Fuel Type

Heating values for selected fuels^[2]

| Name | <u>HHV</u> (MJ/kg) | <u>LHV</u> (MJ/kg) | HHV/LHV | LHV/HHV |
|-----------------------------------|-----------------------|-----------------------|---------|---------|
| <u>Coal</u> ^[a] | 34.1 | 33.3 | 1.024 | 0.977 |
| <u>CO</u> | 10.9 | 10.9 | 1.000 | 1.000 |
| <u>Methane</u> | 55.5 | 50.1 | 1.108 | 0.903 |
| <u>Natural gas</u> ^[b] | 42.5 | 38.1 | 1.115 | 0.896 |
| <u>Propane</u> | 48.9 | 45.8 | 1.068 | 0.937 |
| <u>Gasoline</u> ^[c] | 46.7 | 42.5 | 1.099 | 0.910 |
| <u>Diesel</u> ^[c] | 45.9 | 43.0 | 1.067 | 0.937 |
| <u>Hydrogen</u> | 141.9 | 120.1 | 1.182 | 0.846 |

a) ^ Anthracyte, average

b) ^ Groningen (The Netherlands)

c) ^ Average gas station fuels

http://en.wikipedia.org/wiki/Lower_heating_value



LHV vs HHV CONVERSION FACTORS MUST BE GIVEN FOR EACH FUEL

Heat Content Conversion factor (natural gas)

$1.1\% * \text{LHV} = \text{HHV}$ or $\text{LHV} = 90\% \text{ of HHV}$

Efficiency conversion factor (natural gas)

$\text{LHV} = 1.1 * \text{HHV}$



CHP AND SHP -- MASSACHUSETTS INVESTIGATION

- PACE Energy and Climate Center (PECC)
 - Comments on the Alternative Energy Portfolio Standards Program, Feb. 19, 2009

PECC is concerned about the baseline efficiency levels put forth by DOER. No credits are accumulated unless and until a CHP system meets or exceeds a 50 percent electrical efficiency level and a 95 percent thermal efficiency level¹. Evidence from several experts in this field, including project developers and equipment sales companies, have demonstrated that the effect of these very high standards will be to provide a very small incentive, or no incentive at all, to socially beneficial, high efficiency, low emissions CHP projects in Massachusetts.



CHP AND SHP -- MASSACHUSETTS INVESTIGATION (con't)

■ PECC further commented:

The average electrical efficiency from the grid to the point of end use is typically stated in the range of 30% to 33%, depending upon location, seasonal, peak day and diurnal factors. Though the newest and best gas turbine combined cycle (GTCC) system designs may approach 47% to 50% efficiency this is an inaccurate characterization of the “average” efficiency performance of the grid. Similarly, while an end user may theoretically purchase a 95% efficiency boiler, data indicates that the average boiler efficiency rating for new purchases is less than 83%. The fleet average, including all pre-existing boilers from the very old to newer models, will have an efficiency profile much lower than 83% and an emissions profile much worse than newly available models. We speculate that a substantial portion of incremental CHP systems will come first from the stock of older, perhaps very old, and inefficient boilers.² By setting an attribute standard as high as the one proposed in this instance, the incentive effect will be precluded, or greatly blunted for many otherwise potentially beneficial projects.

Recommendations

- ORNL Report
 - CEC can ask for specific analysis and the supporting data
- HHV vs. LHV
 - Ratio be stated for different fuels: eg., natural gas, landfill gas, digester gas
- CHP metrics
 - Address both topping and bottoming cycles
- SHP and CHP
 - Review investigation of Massachusetts and others



CONTACT INFORMATION

- Eric.R.Wong@Cummins.com