

STANFORD
UNIVERSITY



*20 Page
Cooling Towers
Overall applicable to
Industrial & Commercial applications
H2O to turbines*

March 13, 2009

To: All Interested Parties in CARB CHP Working Group

Subject: Recommendation on Development of Guidelines for Combined Heat & Power

Dear Interested Parties:

Stanford University supports the intent of Assembly Bill 32 to reduce greenhouse gas (GHG) emissions and improve the efficiency of California's energy supply. We also believe that the process unfolding under AB 1613 to facilitate the use of Combined Heat & Power (CHP) could serve AB 32 goals even better through changes that would cause it to promote identification and implementation of the most efficient energy supply option for each site, even if it is based on Separate Heat & Power (SHP) rather than CHP.

Combined Heat and Power (CHP) is an efficient use of natural gas for supplying thermal and electric energy in many cases. However due to innovations in engineering and advancements in equipment technology such as those discussed below there are many other cases where Separate Heat and Power (SHP) options may exceed CHP efficiency. For these reasons, rather than focusing solely on CHP we propose that AB 1613 processes should compel a robust investigation of both CHP and SHP and provide incentives for whichever solution is best for a given application, so long as it exceeds normal efficiency expectations.

Specific Recommendations

We recommend that guidelines establishing technical criteria for eligibility of combined heat & power under AB 1613:


- 1) Recognize that in many cases SHP may offer higher efficiency, lower cost, and less GHG emissions than CHP, and therefore should be eligible for all the same incentives that would be offered to a CHP option;
- 2) Require a site-specific detailed engineering investigation to determine whether CHP or SHP is more efficient and would generate less GHG for meeting electricity and thermal loads at each location under consideration;

Even greater increases in overall plant efficiency are possible through SHP applications using heat recovery, especially when combined with a central cooling system. Wherever a cooling tower is discarding heat into the atmosphere at the same time heat is being produced for heating, drying, hot water, or other low grade heat applications there is an opportunity for heat recovery. CHP and Heat Recovery are typically not compatible, however a heating and cooling overlap of as little as 10% could put an SHP option incorporating heat recovery out of reach of even the best cogeneration plant. Furthermore, where wet cooling towers are used big water savings are also possible with heat recovery.

Stanford Case Study

In 2008 Stanford University performed an exhaustive study of the relative cost and efficiency of CHP and SHP for meeting its long term combined power and thermal loads after the current Cardinal Cogeneration plant (circa 1987) is retired, potentially in 2015 when the current contract for its operation expires.

- For the CHP option a GE LM2500+ cogeneration plant was selected as the optimal fit for Stanford's projected loads, and an overall efficiency of 69% was deemed operationally achievable under steam leading control to avoid the inefficient use of steam for chilled water production. Stanford's Cardinal Cogeneration plant averages 59% efficiency due to its age and excess steam use for chilled water production to facilitate electrical sales to the grid.
- For the SHP option a combination of 85% efficient gas boilers and imported electricity from various sources (IOU, market, 60% CCGT, renewable electricity) was examined.

 During the analysis an astounding 70% real time overlap between low grade heat production and heat rejection via cooling towers at the Stanford central energy facility was discovered, leading to an advanced SHP option we refer to as 'Regeneration'. Figure 1 shows the thermal production overlap and heat recovery potential at Stanford.

The benefit of recovering heat from the chilled water system is further enhanced because machine heat generated by the heat recovery chillers becomes an asset that compliments energy recovered from the chilled water stream for reuse, while with conventional chillers the machine heat is a liability that must be rejected out cooling towers with unwanted heat from the chilled water stream.

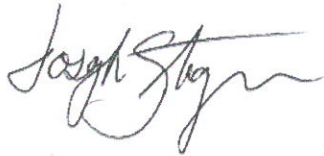
With the use of heat recovery chillers (already commercially available) heat now discarded from the cooling towers at Stanford can be captured and used to meet about 70% of campus heating demands. This will increase overall plant efficiency and reduce cost and GHG emissions by 30%, while also reducing central plant water consumption by 70%.

Summary

In many cases SHP may provide a better option than CHP for meeting long term energy loads at a given site. State regulations promulgated to reduce GHG emissions should assure that a professional due diligence investigation of both CHP and SHP at each site is performed in a standardized and objective manner, and provide that whichever option is best may be eligible for incentives if it meets the definition of 'high efficiency'.

Thank you for your consideration.

Sincerely,

A handwritten signature in black ink, appearing to read "Joseph Stagner". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Joseph Stagner, P.E.
Executive Director- Sustainability and Energy Management
Stanford University