(E-2) Increasing Combined Heat and Power

This Preliminary Recommendation sets a target of an additional 4,000 MW of installed CHP capacity by 2020, enough to displace approximately 30,000 GWh of demand from other power generation sources.[1]

CHP systems, also referred to as cogeneration, generate electricity and useful thermal energy in an integrated system. Combustion-based power plants do not convert all of their available energy into electricity and typically lose more than half as excess heat. By producing both heat and electricity, CHP systems use more of the energy contained in fuel, thereby increasing efficiencies and reducing GHG emissions. The widespread development of CHP systems would help displace the need to develop new or expand existing power plants. This should produce statewide and regional benefits.

CHP systems are generally used in distributed generation applications located at or near electrical and thermal loads. The electricity generated from a CHP system can be either consumed on site or delivered to the grid; the useful thermal energy can be exported to neighboring facilities but is typically consumed on site. By simultaneously reducing fuel requirements for on-site process heaters and electricity generation, CHP systems can be an extremely fuel-efficient and cost-effective form of distributed generation. Some CHP units can be fueled with renewable resources, and those fueled by natural gas generally use less fuel to provide both heat and power than would be used to provide these two services separately.

CHP is used in many different applications. Small units less than 1 MW in size are often installed in places like nursing homes, schools, and laundries. Larger units ranging in size from 5 to 10 MW usually require host sites that have continuous thermal energy needs. Food processors, large data centers and transportation facilities are examples of applications for CHP projects in this size range. CHP projects in the 10 MW to 60 MW range are found in facilities that operate continuously and are sometimes connected at the transmission level, such as chemical plants or oil refineries. Very large units, which can range in excess of 100 MW, feed substantial amounts of power onto the grid for use by other customers as well as serving the thermal and electric needs of the host site.

California has supported CHP for many years, but market barriers stand in the way of CHP reaching its full market potential. A 2005 draft report prepared for the California Energy Commission by the Electric Power Research Institute (EPRI)[2] examined these barriers and their effects upon the market for CHP. EPRI developed estimates of current CHP capacity in the state, estimated technical and economic market potential, and analyzed the costs and benefits of various incentive options to promote development of the CHP market opportunity. Using different forecasts of technology costs, natural gas and electricity prices, and program design, EPRI predicted a potential market for CHP of

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[1] Accounting for avoided transmission line losses of seven percent, this amount of CHP would actually displace 32,000 GWh from the grid.

[2] California Energy Commission, Draft Consultant Report, Assessment of California CHP Market and Policy Options for Increased Penetration. Prepared by Electric Power Research Institute. April 2005.

between 1,966 MW and 7,300 MW over the period 2002-2020.[3] The 7,300 MW modeled under EPRI's "high deployment scenario" represents an increment of more than 5,000 MW above the base case. EPRI concluded that reaching this level of CHP deployment would require fully addressing the export barriers, utility-provided incentive payments, technological advances, the addition of a T&D (transmission and distribution) support payment, and a CO_2 reduction payment. Under their "moderate" scenario, which considered more modest changes in policy and incentives, EPRI predicted a CHP market potential as high as 4,400 MW. It is this estimate that forms the basis for the proposed GHG reduction measure.

Efforts to increase the deployment of CHP may require a multi-pronged approach that includes addressing significant market barriers, incentives where appropriate, and potential mandates.

Small CHP

The Waste Heat and Carbon Emissions Reduction Act[4] requires the CPUC and CEC to evaluate new rules and programs for small CHP systems (up to 20 MW in size). Specifically, the Act directs the CPUC to establish a feed-in tariff – a pre-negotiated price that utilities would pay for excess electricity that is fed into the grid. Under the Act, the CPUC may require the state's IOUs to purchase specified amounts of excess electricity from CHP customers that comply with specified sizing, energy efficiency, and air pollution control requirements. The statute also authorizes the state's POUs to purchase excess electricity from CHP systems at a rate determined by their governing boards. The Act furthermore requires the CPUC to evaluate a pay-as-you-save pilot program that would provide up-front financing to nonprofit organizations for the development of up to 100 MW of power.

Because the statute does not specifically mandate the CPUC to require participation of the state's IOUs, or require the state's POUs to create specific programs for their customers, the Act's potential to encourage the development of small CHP systems (under 20 MW) CHP is currently unknown. This legislation represents a step toward opening the wholesale market for smaller CHP projects. However, because the statute does not compel the CPUC impose requirements on the state's IOUs, or require the state's POUs to create specific programs for their customers, it stops short of providing small CHP operators with the guaranteed access to wholesale markets recommended in the CEC's *Integrated Energy Policy Report*[5]. In order to ensure that the target level of CHP is achieved by 2020, it may be necessary to require utilities to buy back excess power. Another option would be for the state to mandate CHP for certain types of new or existing industrial, commercial and institutional facilities.

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[4] AB 1613 (Blakeslee, Chapter 713, Statutes of 2007)
[5] California Energy Commission, 2007, *2007 Integrated Energy Policy Report*, CEC-100-2007-008-CMF

Medium and Large CHP

The majority of energy and GHG savings in the future may come from larger CHP systems. As with smaller CHP systems, the key difficulty faced by larger CHP owners is the inability to sell excess electricity to the grid. Sizing CHP systems to operate efficiently often results in the generation of excess electricity. Without a market for this power, many CHP systems may not provide adequate economic return.

Specific actions that have been identified as necessary to create a viable market for CHP system power include:

- Creating utility portfolio standards for CHP power;
- Encouraging power export so CHP systems are optimally sized for onsite heat loads and large enough to provide T&D capacity to utilities; and
- Developing guaranteed rate structures and market access for CHP power that appropriately value the electrical system and environmental benefits of CHP power[6]

The CPUC intends to open a rulemaking focusing exclusively on CHP this year. During this proceeding, the CPUC is expected to explore regulatory issues that directly affect the development of ultra-clean CHP, and to make decisions regarding how to facilitate the development of efficient and environmentally beneficial CHP. This will require discussions about how CHP generators can participate in a generation market that requires scheduling hour-by-hour exports with the CAISO. Meanwhile, the CEC will continue its efforts to support the development of an active CHP market through research and policy-setting activities.

While CHP systems use fuel more efficiently than centralized power plants, they have the effect of increasing fuel use on-site. The potential emissions from CHP systems varies significantly depending upon the system size and type of technology used,[7] but the increase in fuel use generally causes increased emissions of CO_2 on-site. Potential local adverse effects need to be prevented or mitigated through the existing air permitting process.

Benefits and Costs

In addition to the energy cost savings and carbon emission reduction benefits, the development and use of well-designed additional CHP systems in California offer other environmental and power generation/distribution benefits. Reliable baseload or load-following CHP can:

- Provide an alternative to new central station fossil-fuel generation and reduces the need for new transmission and distribution infrastructure.

[6] California Energy Commission, 2007, *Distributed Generation and Cogeneration Policy Roadmap for California*., CEC-500-2007-021

[7] Molten carbonate fuel cells, for example, convert chemical energy directly into electricity while producing very little pollution. (Kaarsberg, 2001)

- Improves the efficiency, reliability and security of the State's electricity system and reduces losses during peak hours.
- Provide valuable protection against supply outages and brownouts, especially at oil refineries.
- Provide more efficient fuel use, reduced energy costs and the most efficient and cost-effective form of distributed power generation.
- Effectively reduce transmission and distribution congestion.
- By offsetting more expensive peak electricity, provide potential cost savings to the host site.

For purposes of estimating GHG reductions, ARB staff estimated the electric generation potential from CHP (or the amount of electricity offset from the grid, based on an assumed 85 percent capacity factor), the total amount of fuel consumed onsite, and the amount of waste heat generated for useful thermal purposes (which was then used to calculate the amount of fuel not consumed to produce that amount of thermal energy). Emission gains and reductions were calculated for each of these elements and the net emission reductions are shown in the table below. Capital costs were annualized assuming a 30-year system lifespan and operating costs were estimated based on fuel inputs.

Appendix C: Electricity and Natural Gas - Preliminary Recommendations
Table 1

Reduction Measure	Potential 2020 Reductions $MMTCO_2E$	Net Annualized Cost ($ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
E-2: Increasing Combined Heat and Power Use by 32,000 GWh	6.8	-1,311	CPUC & CEC	2009-2020

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.