Agenda Item 4.A.

CALIFORNIA ALTERNATIVE ENERGY AND ADVANCED TRANSPORTATION FINANCING AUTHORITY

Meeting Date: September 24, 2008

Consideration of Staff Recommendation Regarding Financing District Heating and Cooling Projects

Prepared by: Meg Waltner

Issue. As a matter of policy, should CAEATFA provide private activity bonds for district heating and/or cooling (DHC) projects that use near-zero emission[1] heating and/or cooling (ZEH/C) technologies such as advanced solar thermal (AST), fuel cell, or geothermal?

Background. Under CAEATFA's authorizing statute, CAEATFA's purpose is to provide industry in California with alternative methods of financing for renewable energy and advanced transportation technologies. The statute defines renewable energy sources as: "The application of cogeneration technology; the conservation of energy; or the use of solar, biomass, wind, geothermal, hydroelectricity under 30 megawatts or any other source of energy, the efficient use of which will reduce the use of fossil and nuclear fuels." (California Public Resources Code Section 26003 (c.1))

The implementation of ZEH/C systems using AST, fuel cell, and geothermal technologies could result in significant greenhouse gas (GHG) reductions. In 2005, Governor Schwarzenegger issued Executive Order S-3-05 establishing a goal to reduce GHG emissions to 1990 levels by 2020 and to 80 percent below 1990 levels by 2050.[2] In 2006, the passage of AB32 set the 2020 emissions goal into law and commissioned the California Air Resources Board (CARB) to develop a scoping plan for how California will achieve this emissions goal. The draft scoping plan, which was released in June, does not directly mention DHC as it is currently somewhat limited in California; nonetheless, as an efficient way to deliver energy, it should be further promoted under AB32 and other measures. The Economic and Technology Advancement Advisory Committee (ETAAC) report, which informed the scoping plan, supports this assertion, as it identified significant GHG reduction potential from AST, geothermal and fuel cell technologies.

Despite the potential ZEH/C to reduce GHG emissions, there is little policy in place that addresses its deployment. Although some policies exist that encourage the use of solar thermal, geothermal and fuel cell technologies, they generally do not apply to DHC systems. For instance, the California Solar Initiative (CSI) included solar thermal air conditioning in their non-photovoltaic draft handbook, but used the same sizing criteria as for photovoltaic (PV) systems, which effectively excludes DHC systems. Other terms of the PV program cannot be readily applied to AST; therefore, the reality is that no AST projects are currently moving forward under the program. Additionally, the Solar Water

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[1] Near-zero emission is defined as a technology that produces no or low GHG emissions during use. For instance, geothermal heat pumps count as a ZEH/C technology even though they may require some electrical energy to pump fluids, which may result in GHG emissions.

[2] Executive Order S-3-05, Governor Schwarzenegger, June 1, 2005

Heating and Efficiency Act of 2007 (AB 1470) calls for the installation of at least 200,000 solar water heating systems in California by 2017; however, this program is targeted at home systems and very small commercial systems. Further and of primary importance is the fact that neither of these policies allows for technology that displaces both gas and electricity using a single system. The one exception to the many solar incentives that do not apply to AST DHC is the property tax exemption for all solar energy systems, which was extended to Dec 31, 2009 by AB1099. Similarly, fuel cell incentives (the California Energy Commission's Emerging Renewables Program and the Self Generation Incentive Program) only apply to electricity generation and so do not explicitly encourage the deployment of these technologies for DHC systems. Finally, there are no state level incentives for shallow geothermal DHC, the type of geothermal energy most readily available for DHC systems.

In addition to the lack of policy, there are several other barriers that have impeded the widespread implementation of DHC using AST, geothermal, and fuel cells in California. First, DHC systems are not widespread due to lack of awareness of the efficiency advantages they offer, but more importantly, due to the lack of ready mechanisms to facilitate what are community-type systems. Second, as with the renewable technology that would power them, DHC systems face the same financial barriers that many renewables face: they have high capital costs and compete with artificially low fossil fuel prices, which don't take into account the costs of externalities. Another barrier is simply lack of awareness and familiarity with the technologies since they have not yet been widely deployed. Additionally, regarding AST specifically, solar thermal has an undeserved bad reputation due to poorly built systems installed in the early 80's under faulty incentive programs, which are not representative of current technology. California has one of the best solar resources in the country, has significant geothermal resources, and is a leader in fuel cell utilization; to pair these resources with DHC systems would further California's deployment of renewable energy.

Technology Overview.

Distributed Generation. Distributed generation (DG) refers to energy generated by small-scale energy systems on-site or close to the end-use location, rather than at a central power plant. DHC is a form of DG as it provides heating, cooling and/or electricity at the site of use. Other examples of DG are solar PV, microturbines, solar water heaters, small wind turbines, and microhydropower. DG offers many advantages over centralized power, such as higher reliability and lower transmission and distribution losses and costs.

District Heating and/or Cooling. DHC systems can provide space heating, space cooling, process heating, process cooling, and/or domestic hot water through a central piping system that distributes heating and cooling in the form of steam or hot water and chilled water or air. By definition, a DHC system provides energy to buildings with multiple users or to groups of buildings, such as government buildings, campuses, prisons, hospitals, hotels, apartment complexes, and industrial buildings. DHC is often used interchangeably with the term combined heat and power (CHP), although a DHC system does not necessarily produce electricity and a CHP system does not necessarily produce cooling and is not necessarily a district system. DHC systems can be fueled by a variety of renewable and conventional energy sources. For DHC systems that also produce electricity, efficiencies can be as high as 60-80 percent, a great improvement over the 33 percent of a typical power plant.[3] This efficiency advantage also applies when using thermal energy to displace electricity for cooling purposes. Renewable district cooling can be used in lieu of a cooling system powered by electricity, providing a huge opportunity to cut electric air conditioning demand in the summer.

DHC currently only provides about 5 percent of the energy used for heating and cooling in the US. This number is largely driven by DHC using fossil fuel-fired cogeneration.[4] According to the ETAAC report, there are currently over 9,200 MW of CHP installed at 900 sites throughout California. By 2020, California could add between 2,000 MWe and 7,300 MW of new CHP capacity, resulting in CO_2 reductions of between 1.5 million and 6 million tons per year. CHP systems can reduce CO_2 emissions by 20 to 25 percent compared to separate processes for generating electricity and thermal energy. If DHC systems used renewable energy sources, even more GHG reductions would be realized.[5]

Advanced Solar Thermal. Advanced Solar Thermal (AST) systems collect solar thermal energy through a rooftop-type collector. They use this thermal energy for space heating and cooling, process heating and cooling, district heating and cooling, and large scale domestic hot water. They differ from traditional solar hot water systems in that they produce water at temperatures[6] high enough to run a chiller to produce cold water or air which can provide space and process cooling. AST systems are individually engineered, generally have O&M provided, are commercial quality, have longer paybacks, and allow for large domestic hot water systems. A schematic diagram of an AST system is shown in figure 1.

AST Collectors. There are two main types of AST collectors used for DHC: flat plate and evacuated tube. Flat plate collectors are generally simpler and cheaper than evacuated tube collectors. They are typically made of an insulated metal box with a glass or plastic cover and a dark-colored absorber plate. Liquid or air circulates through the collector and is generally heated to temperatures less than 180°F. Due to their lower temperatures, these collectors are commonly used for domestic hot water only systems. However, some companies have been able to produce water at 200-225°F by using increased insulation and reflective coating, which allows flat plate collectors to also be used for cooling applications. See figure 2 for a drawing of a flat plate collector.

Evacuated tube collectors can produce higher water temperatures ranging from 170°F to 350°F and are generally about twice as expensive as flat plate collectors. The collectors usually consist of parallel rows of glass tubes. These tubes are made of a transparent

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[3] http://www.eere.energy.gov/de/chp/chp_technologies/tech_basics.html

[4] http://yosemite.epa.gov/oar/GlobalWarming.nsf/UniqueKeyLookup/SHSU5BPLD4/$File/combinedheatandpower.pdf

[5] ETAAC report, pg. 10-64

[6] Typical solar hot water systems produce water at 140°F. AST collectors produce water from 200°F to above 600°F.

outer tube and then an inner metal tube. There is no air in the space between the two tubes, which prevents conductive and convective heat loss.[7] See figure 2 for a drawing of an evacuated tube collector.

A third type of collector, the parabolic trough, may also be used for heating and cooling applications. Parabolic troughs are more expensive and mechanically complicated than either of the other two collector types described, but in turn are capable of producing water above 600°F. They consist of reflective troughs which track the sun in a single-axis and concentrate solar energy onto a collector tube, through which fluid is circulated. They are more commonly used in large scale solar power plant applications.[8]

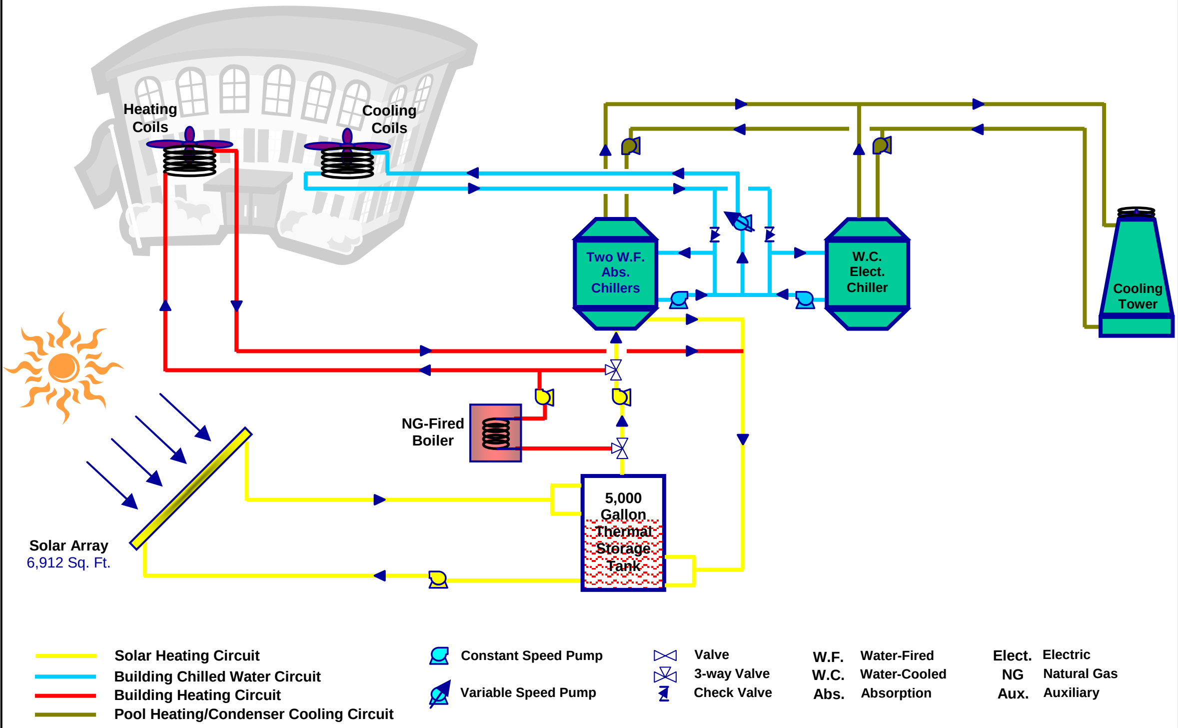

Figure 1. Schematic diagram of an AST heating and cooling system. Note that this schematic only shows one building, while a district system would serve multiple "users."

Chillers. In order to convert solar thermal energy into cooling, AST systems use absorption or adsorption chillers. Absorption chillers are more common, as adsorption chillers are a newer technology. Both chiller types are similar to the common vapor compression chiller (used in refrigerators and air conditioning), but use thermal heat instead of a mechanical compressor to create the high pressure vapor. Vapor compression

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[7] http://www1.eere.energy.gov/solar/sh_basics_collectors.html#flatplate
[8] http://www.nrel.gov/docs/fy06osti/39459.pdf

chillers create cooling by allowing the refrigerant to expand (decrease in pressure) and consequently drop in temperature. This refrigerant can be an environmentally benign salt. See figure 3 for a schematic drawing of a vapor compression chiller cycle.

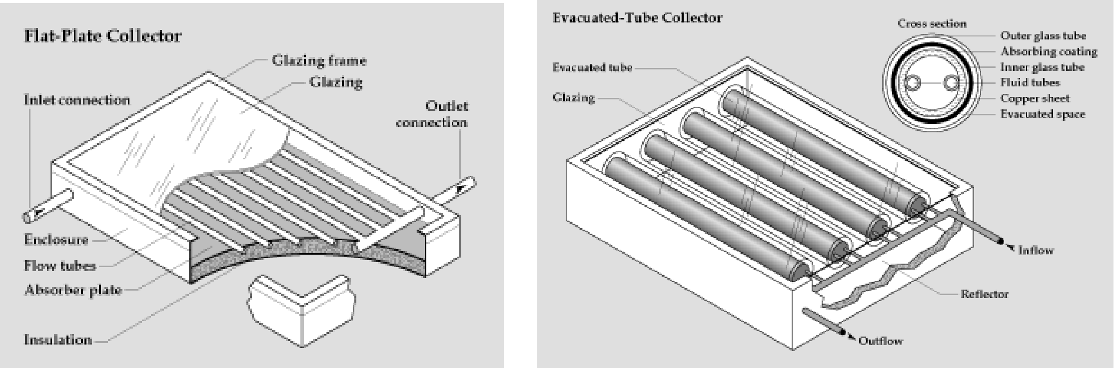

Figure 2: Schematic drawings of flat plate and evacuated tube solar thermal collectors.[9]

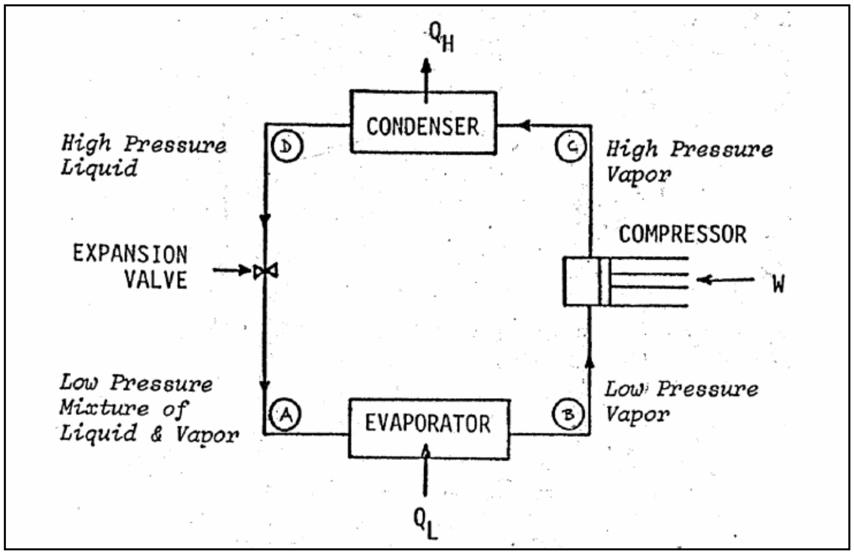

Figure 3: Schematic drawing of a vapor compression chiller cycle. This chiller is similar to absorption and adsorption chillers, which use heat, rather than a mechanical system, to compress the vapor.

Current Status and Potential. Although AST DHC systems are commercially available, they have not been widely implemented in the US. As of 2005, there were 88 gigawatts-thermal (GWth) of solar thermal systems installed worldwide, provided by 46 million systems. However the majority of this energy is from systems which are limited to providing hot water rather than space heating or cooling. Additionally, these systems typically provide energy to a single building rather than a district, and are deployed mostly in China, Japan, India, Korea, Israel and the European Union.[10] Many countries are currently encouraging solar hot water technology; worldwide installations grew 14% in 2005, led by China with almost 80 percent of the additions. There is significantly less

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[9] http://www1.eere.energy.gov/solar/sh_basics_collectors.html#evacuatedtube

[10] ETAAC Report, pg. 10-43

data on the deployment of AST cooling systems, but estimates of the number of installed systems and capacity in Europe range from 40 to 200 and 4.4 MWth to 12 MWth, respectively. Only 5 to 10 AST cooling systems have been deployed in the US, while the majority of systems so far have been installed in Germany, Spain, and Greece.[11]

AST is a proven technology, and California could achieve significant GHG reductions from its implementation. According to an NREL study, 65 percent of residential and 75 percent of commercial buildings in California could be outfitted with solar collectors for hot water systems. Although this study considered hot water only systems, which are smaller, a considerable portion of these buildings could likely be retrofitted for AST systems as well. Furthermore, the NREL study calculated 7.8 to 8.6 MMT CO_2 potential annual reductions from solar hot water systems and the AST industry currently estimates in excess of 15 MMT CO_2 reduction potential annually from AST systems.[12]

Residential and commercial building energy usage in California is significant with industry accounting for 20 percent of California's annual GHG emissions.[13] A DHC system could be included in an industrial area to serve more than one process, for example, to serve numerous food processing plants. With AST and its higher heat production, such an application could have an exceptional impact on lowering fossil fuel usage and CO2 emissions. The solar thermal industry is also currently evaluating usage on a variety of energy intensive processes.

Fuel Cells. Fuel cells produce electricity and heat electrochemically by combining a fuel and an oxidant. Common fuels include hydrogen, hydrocarbons (natural gas, diesel, waste or digestor gas), and alcohols (methanol, ethanol). The most common oxidant is oxygen, but other oxidants include chlorine and chlorine dioxide. Fuel cells work similarly to batteries, but unlike a battery, they continually intake fuel and therefore are not depleted. In order to create electricity, the fuel flows over the anode. The anode is a catalyst that separates the electrons from the positive ions. The positive ions can flow through an electrolyte, while the electrons are forced to flow through an electric circuit, generating electricity. The positive ions, electrons, and oxidants are then recombined on the cathode, another catalyst. In the case where hydrogen is the fuel, the end products are water and heat. This heat can be used for district heating or can be used to drive chillers (described above) to provide cooling. When other carbon-based fuels are used, fuel cells also produce carbon dioxide. See figure 4 for a schematic diagram of a generic fuel cell.[14]

There are several types of fuel cells that serve a variety of applications. Specifically fuel cells can provide stationary power and heat, transportation power, and portable power. The main distinctions between different types of fuel cells are their operating temperatures and the type of electrolyte used. Examples of types of fuel cells are: molten carbonate or phosphoric acid, proton exchange membrane, molten carbonate, solid oxide, alkaline, direct methanol, regenerative, zinc air, protonic ceramic, and microbial.

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[11] IEA, "Renewables for Heating and Cooling: Untapped Potential,"
[12] ETAAC Report, pg. 10-43
[13] Draft Scoping Plan, pg. 7
[14] http://www1.eere.energy.gov/hydrogenandfuelcells/fc_animation_components.html

Fuel cells with higher operating temperatures, such as phosphoric acid fuel cells, have applications in DHC, while those with lower operating temperatures, such as proton exchange membrane fuel cells, are generally better suited for transportation applications. See http://www.fuelcells.org/basics/types.html for more information on specific types of fuel cells.[15]

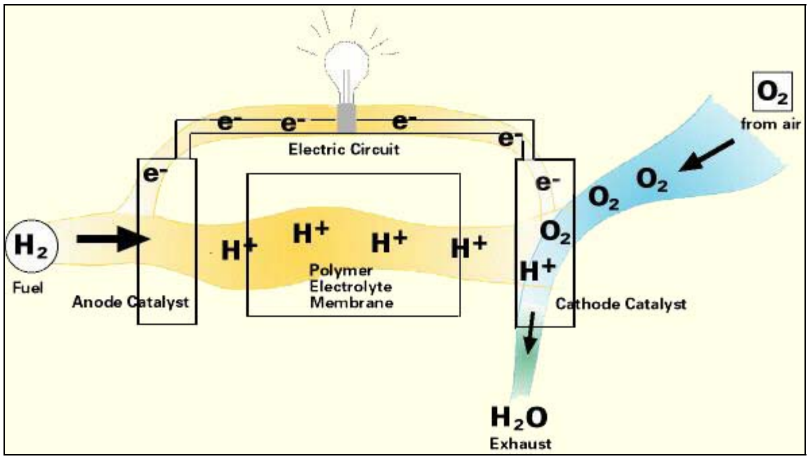

Figure 4: Schematic drawing of a fuel cell.[16]

Current Status and Potential. Fuel cells are primarily used to generate electricity and heat that can be used at consumer sites or in district or campus applications. Over 2500 stationary fuel cell systems have been installed worldwide. California has installed more than 15 MW of fuel cell capacity since 2003. About half of the installed capacity is customer generators, while the remaining half is for utility and waste water treatment facility power plants. The majority of these installations operate on renewable fuels, specifically anaerobic digester gas. Within California additional renewable fuels in the form of landfill gas and manurer digesters at daries could produce over 1,00 MwW of fuel cell power and renewable ZEH/C.[17] A PBI incentive directed at the ZEH/C application would further result in the increased usage of these renewable fuels that are currently combusted in an effort to dispose of them.

Similar to the process previously described for AST projects, thermal energy from fuel cells can be used in an absorption or adsorption chiller to produce cooling as a byproduct of the energy generation process. A 1 MW fuel cell would produce sufficient waste heat to operate a 200-ton absorption chiller that would either offset or replace a conventional electric chiller[18]. The most common use of waste heat from fuel cells among the 20 MW of operational projects in California takes the form of hot water and replaces the use of a boiler.

A representative example of this type of ZEH/C can be seen at the Sheraton Hotel in San Diego where a 500 kW fuel cell serves a 300-room hotel and conference facility. On an

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[15] http://www.fuelcells.org/basics/types.html

[16] http://auto.howstuffworks.com/framed.htm?parent=fuel-cell.htm&url=http://www.fuelcells.org

[17] U.S. EPA Landfill Methane Outreach Program statistics.

[18] Fuel Cell Energy and UCI / National Fuel Cell Research Center calculations.

annual basis, the fuel cell supplies 100% of the hotel's aggregate electrical demand while its thermal output replaces a set of boilers. The boilers no longer consume any gas as the fuel cell meets 100% of the load required for domestic hot water, kitchen usage, and laundry usage. Additional thermal energy is available for potential usage by an absorption chiller and a PBI program stimulating ZEH/C could enable the use of this additional energy source.

Unlike AST systems, fuel cells can deployed almost anywhere as they are not dependent on site conditions, such as roof size and orientation. There are no estimates of the potential GHG reductions from fuel cells in DHC systems. CAEATFA staff estimates that the potential is large, as industrial, commercial and residential heating and cooling account for over 20% of California's GHG emissions annually. Although not all of these emissions could be captured through DHC applications, and not all DHC applications would use fuel cells, these numbers show that there are significant potential reductions from fuel cell DHC.

Geothermal. There are two main types of geothermal energy systems: deep and shallow. Deep geothermal energy comes from heat reservoirs of steam or hot water that can be up to several miles below the earth's surface. Deep geothermal energy is typically used for power generation (with some potential for use in DHC systems), and is site specific to locations where geothermal resources exist. The major identified deep geothermal resource areas in the state are: the Geysers north of San Francisco, Northeastern California, Western Nevada, the Mammoth Lakes area, Coso Hot Springs in Inyo County, and the Imperial Valley.

Shallow geothermal energy systems, also known as geothermal heat pumps, are used exclusively for heating and cooling applications and can be deployed almost anywhere. Geothermal heat pumps use the earth's constant temperature (generally between 50 and 60°F) to provide heat in the winter, or serve as a heat sink during the summer. An external energy source must be used to move the heat "uphill," but coefficients of performance (COP) for geothermal heat pumps are high, generally in the range of 3 to 6.[19] Although both deep and shallow geothermal systems are eligible for private activity bonds through CAEATFA, this report focuses mainly on shallow systems as they are more widely applicable and relevant for DHC consideration.

Shallow Geothermal Systems. There are four main types of shallow geothermal systems: horizontal, vertical, pond/lake, and open loop. Horizontal systems are generally the most cost-effective for residential installations, particularly for new construction where sufficient land is available. They generally consist of either two pipes, one buried at six feet and the other at four feet, or two pipes placed side-by-side at five feet in the ground in a two-foot wide trench. Sometimes looping pipes are installed to reduce the surface area required for the system.

Large commercial buildings and schools often use vertical systems because there is not enough surface "footprint" for a horizontal system. Vertical systems consist of holes

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[19] http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12640

(approximately four inches in diameter) drilled about 20 feet apart and 100–400 feet deep. These holes have two pipes each that are connected with a U-bend at the bottom.

Where water resources are available nearby, pond or lake systems can be the lowest cost option and consist of coils placed at least 8 feet below the surface of a lake. Similarly, when the resources are available, open-loop systems can use well or surface body water as the heat exchange fluid that circulates directly through the heat pump system. Once it has circulated through the system, the water returns to the ground through the well, a recharge well, or surface discharge. Of the four system types, vertical systems are most likely to be used for geothermal DHC systems. See figure 5 for schematic drawings of the various types of shallow geothermal systems.[20]

Current Status and Potential. California has the largest developed deep geothermal resources in the U.S. at approximately 1,900 MW. In 2006, 4.7 percent of California's electric energy generation came from geothermal power plants. Fifteen deep geothermal projects are currently in some form of development in California, which will amount to an additional 921.3-969.3 MW of capacity. The City of San Bernardino has one of the largest geothermal district heating projects in North America. That project heats 37 buildings with fluids sent through 15 miles of pipelines.[21] In terms of shallow geothermal energy, more than 600,000 ground-source heat pumps had been installed in the United States by the end of 2005, with new installations occurring at a rate of 50,000 to 60,000 per year.[22] According to the EPA geothermal heat pumps can cut energy use by 70 percent and therefore significantly reduce GHG emissions.[23]

Similarly to fuel cells, there are no technical estimates of the total potential GHG reductions in California from the implementation of geothermal DHC. Although geothermal DHC is more site-specific than fuel cell DHC, the entire heating and cooling sector represents such a large percentage of California's GHG emissions that geothermal DHC is also likely to have significant potential reductions.

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[20] http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12650

[21] ETAAC Report, pg. 10-35

[22] http://www.ucsusa.org/clean_energy/renewable_energy_basics/offmen-how-geothermal-energy-works.html

[23] http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12660

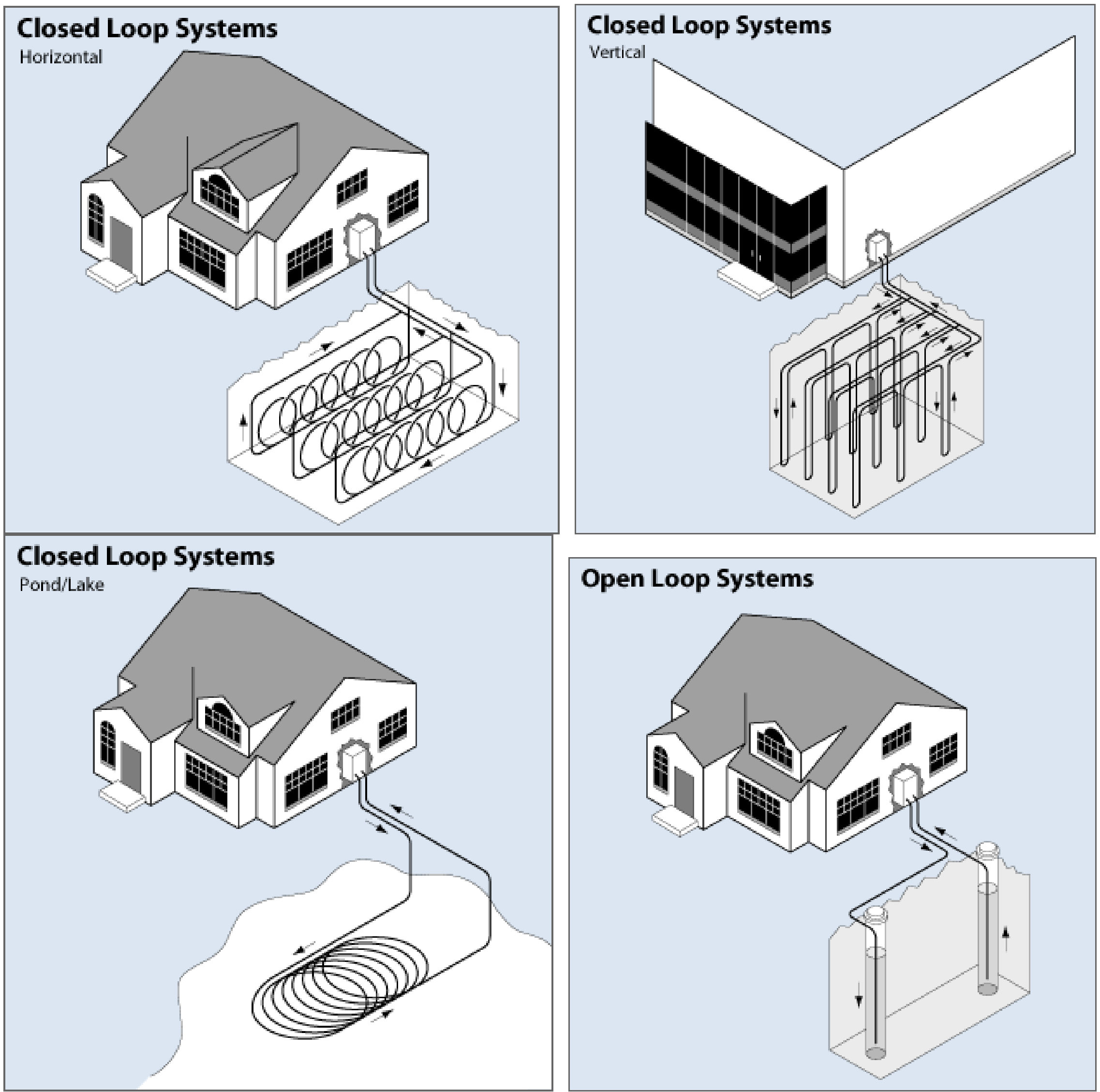

Figure 5: Schematic drawings of four types of geothermal heat pump systems. [24]

<u>Federal Tax Code</u>. Under the Internal Revenue Code, section 142 (g), CAEATFA may issue tax-exempt private activity bonds to finance local district heating or cooling facilities. A local district heating or cooling system is any local system consisting of a pipeline or network providing hot water, chilled water, or steam to two or more users for: residential, commercial or industrial space, water, or process heating, cooling, or steam. The term "user" focuses on the parties who physically use the energy services provided by the DHC system. The private activity bonds may be used to pay for the "district" portion of the system that transports the heating or cooling only, but not the energy system itself. Specifically, private activity bonds for a DHC system may not be used to pay for the AST collectors, fuel cells, chillers, or heat exchangers. Soft costs of creating the district portion of the DHC system, such as design and labor, are eligible for funding through private activity bonds, as any cost of creating the physical asset is considered a

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[24] http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12650

capital expense. Another requirement of private activity bonds is that they must satisfy the public use requirement.

CAEATFA also has the authority to issue private activity bonds for qualified 501 (c)(3) non-profits under Internal Revenue Code, section 145 (a). CAEATFA could use this authority to issue private activity bonds for DHC systems for non-profits. These bonds would be less restrictive than those specifically for DHC described above, as they could be used for the whole project cost and for a project with only one user. In order to qualify for tax-exempt financing, the ownership and operation of the DHC system would have to be substantially related to the charitable purposes of the non-profit.

Pros. **Greenhouse Gas Reductions:** DHC using renewable technologies provides significant potential GHG reductions. CAEATFA staff estimate that more than 25% of California's GHG emissions, 125 MMTCO2e annually, come from commercial, residential and industrial space, process and water heating and cooling. The calculations behind this estimate are summarized in Table 1. Although not all of this heating and cooling could be served by district systems, the fact that this sector accounts for a quarter of California's annual emissions shows that it is a place with huge potential for GHG reductions.

All Sector Space Heating/Cooling and Water Heating/Cooling GHG Emissions **(MMTCO2e)**[25]	Average Annual GHG Emissions	Percentage for Thermal Uses	Total Annual GHG Emissions from Thermal Uses
Residential Energy Use (Excluding Electricity)	29[26]	88%[27]	26
Commercial Energy Use (Excluding Electricity)	12[28]	68%[29]	8
Residential Electricity Use	28[30]	20%[31]	6
Commercial Electricity Use	33[32]	28%[33]	9
Industrial Energy Use (Excluding Electricity)	96[34]	80%[35]	77
Total Annual CA GHG Emissions from Thermal Uses			125
Total Average Annual CA GHG Emissions			469
Percentage of Emissions for Thermal Uses			27 %

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[25] Table 1: Staff Calculation of annual GHG emissions in California from space, process, and water heating and cooling in the residential, commercial, and industrial sectors. All GHG emissions are in units of MMTCO2e and are based on average values from 2000-2004. Numbers may not add up to totals due to independent rounding.

In addition to CAEATFA staff estimates, a study by KEMA, an energy consulting group, found that solar hot water systems alone could save more natural gas than any other technology in California. In 2007, an NREL study found that solar hot water systems alone could reduce emissions by 7.8 to 8.6 MMT CO_2. Furthermore, the AST industry currently estimates in excess of 15 MMT CO_2 reduction potential from AST systems in California.[36] To put these numbers in perspective, AB32 calls for a reduction of 169 MMTCO2e and the million solar roof initiative is expected to provide 2.1 MMTCO2e of these reductions.[37] DHC using geothermal and fuel cells has great reduction potential as well, as these systems can be used almost anywhere and are not limited by roof characteristics like AST. Fuel cells fueled by waste or digestor gas provide additional GHg reductions (1.59 tons per MWh)[38] as they usetilze renewable gases that would ordinarily be treated as a wast product and destroyed via combustion.

Additional Benefits. In addition to the GHG reductions by using renewable energy sources for heating and/or cooling, employing them as DG and district systems result in a variety of indirect benefits. Specifically, renewable space cooling can reduce the peak electricity load during the summer, which results in additional environmental, GHG reduction, and economic benefits as the power plants used for peak power are generally the dirtiest and most expensive to operate. This has particular potential in terms of AST, because solar availability and space cooling demand are highly correlated. The employment of renewable DG also avoids the cost of increased generation capacity (both capital and operation and maintenance costs), of transmission and distribution (both building capacity and efficiency losses), and of fuel. DG offers the additional benefits of deployment ease and speed, grid independence, fossil fuel price hedge, reduced water use, and reduced health effects. Finally these systems are cost effective over time and often more cost effective than other renewable options, with the potential for large savings from the investment.

Cons. ZEH/C is a relatively new application of solar thermal technology. Although ZEH/C are commercially proven and available technologies, there is still the risk that systems will not be installed properly since there are few experienced US companies.

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[26] California Greenhouse Gas Inventory
[27] California Energy Efficiency Strategic Plan, Section 2, Page 8
[28] California Greenhouse Gas Inventory
[29] California Energy Efficiency Strategic Plan, Section 3, Page 25
[30] Calculated by multiplying 86 MMTCO2e (California Greenhouse Gas Inventory), the total annual GHG emissions from CA electricity use, by 32 % (California Energy Efficiency Strategic Plan, Section 2, Page 7), the amount of CA electricity used by the residential sector.
[31] California Energy Efficiency Strategic Plan, Section 2, Page 8
[32] Calculated by multiplying 86 MMTCO2e (California Greenhouse Gas Inventory), the total annual GHG emissions from CA electricity use, by 38 % (California Energy Efficiency Strategic Plan, Section 3, Page 25), the amount of CA electricity used by the commercial sector.
[33] California Energy Efficiency Strategic Plan, Section 2, Page 8
[34] Draft Scoping Plan, p. 8
[35] US Department of Energy, Energy Efficiency and Renewable Energy Program, Industrial Technologies Program, http://www1.eere.energy.gov/industry/energy_systems/
[36] ETAAC Report, pg. 10-43
[37] CARB Draft Scoping Plan
[38] Itron SGIP Sixth Year Impact Evaluation, August, 2007, pg. 1-19.

Faulty installations could impede successful deployment of ZEH/C technologies, preventing it from achieving its potential GHG reductions. In the mid 1980's, California had a poorly designed solar thermal tax credit program that hurt the industry more than helped it. CAEATFA staff recommended in a September 2008 filing to CARB that they require electric and gas utilities to implement a performance based incentive for ZEH/C systems that rewards system output (encourages innovation and fosters competition). A properly designed ratepayer incentive program will help ensure that ZEH/C projects achieve their potential GHG reductions. Additionally, since CAEATFA would issue the bonds before the system is installed, there is no way to reward performance overtime which increases the risk of poorly installed systems. The same risk applies to geothermal and fuel cell DHC systems, as these are also nascent technologies.

Another potential risk of offering private activity bonds for DHC is that if energy prices were to decrease, profitability of these systems could put these projects in financial jeopardy. This may affect some owners' ability to pay back the bond if they are paying out of an energy budget that is based on current energy prices.

Staff Recommendation. Staff finds that there is evidence that the implementation of DHC using ZEH/C technologies in California would provide significant greenhouse gas reductions, green jobs, economic expansion, and reduce the state's dependence on foreign oil. Therefore, staff recommends that the Authority direct staff to consider applications for private activity bonds for DHC fueled by ZEH/C technologies, such as AST, geothermal, or fuel cell technologies. Staff acknowledges that applications for DHC projects will be evaluated on their individual benefits, including their energy efficiency, GHG emissions reductions, pollution reduction, and job creation potential.