STAFF PAPER

Geothermal Heat Pump and Ground Loop Technologies

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ABSTRACT

The *Geothermal Heat Pump and Ground Loop Technologies* staff paper provides a brief overview of these technologies and their barriers to more widespread use in California. The paper details the barriers faced by the geothermal industry, as well as proposed solutions suggested by industry. It also provides the California Energy Commission staff's responses to industry proposals. Topics covered in the paper include California Building Energy Efficiency Standards modeling compliance, local permitting and fee schedules, installation practices, *Geothermal Heat Exchange Well Standards,* well log data; tiered electricity rates, utility-based loop lease programs, industry request for consideration of geothermal heat pumps as a renewable resource, and estimating avoided greenhouse gas emissions.

Keywords: Geothermal heat pump, efficiency, open-loop system, closed-loop system, geothermal heat exchange wells, boreholes, permitting, well log data, alternate calculation method, renewable

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EXECUTIVE SUMMARY

Assembly Bill 2339 (Williams, Chapter 608, Statutes of 2012), requires the California Energy Commission to evaluate policies to overcome barriers to the use of geothermal heat pump and geothermal ground loop technologies in California, and to include these evaluations and recommendations in the *2013 Integrated Energy Policy Report* (*IEPR*). Using the relatively constant temperature of the ground, the technology is used to both heat and cool buildings. In winter, heat from the warmer ground is transferred to a water-source heat pump, which provides warm air for the home or business. During hot weather, the process is reversed. Geothermal heat pumps typically result in significant energy efficiency gains over conventional building space conditioning and domestic hot water and have proven to work well with other renewable resource applications such as photovoltaic systems and solar hot water. Geothermal heat pumps have existed in the United States for more than 50 years.

To solicit stakeholder feedback on potential geothermal heat pump barriers, the Energy Commission held a workshop on March 21, 2013, and subsequently developed a working group with other state agencies, cities, counties, and interested parties to begin evaluating current policies. This paper outlines the input received during the working group process and provides additional detail on the high-level discussion included in the *2013 IEPR*. While the paper summarizes the views of the geothermal heat pump industry as discussed by the working group and represented in written comments, the industry positions presented here do not necessarily reflect the views of all members of the working group. The paper is not intended to be an exact record of the discussions that took place in the working group, but generally reflects topics covered and some subsequent analysis by Energy Commission staff.

Barriers raised by industry broadly include local permitting and regulatory issues, cost, and how best to capture the benefits of geothermal heat pump technologies in state policy. This staff paper identifies the existing barriers to the use of geothermal heat pumps and includes both the geothermal heat pump industry view on how to address these issues as well as Energy Commission staff recommendations.

Building Standard Models Do Not Accurately Reflect Geothermal Heat Pump Characteristics

The first barrier discussed concerns system modeling to show compliance with the *California Building Energy Efficiency Standards* modeling compliance. These standards require modeling of most buildings to demonstrate compliance tradeoffs allowed within the standards. Both the building industry and Energy Commission staff generally agree that these models do not accurately represent the efficiency of geothermal heat pump systems. This inaccurate representation presents a barrier to the industry because the model does not sufficiently estimate GHP energy consumption to allow for direct comparison to the energy consumption of conventional heating, ventilation, and air conditioning systems.

Currently, building owners proposing to install geothermal heat pumps may not qualify for utility rebates, because rebate programs generally require buildings be modeled with

Energy Commission-approved compliance models, and these models do not represent geothermal heat pumps well (or sometimes at all). In addition to demonstrating standards compliance, incentive programs often require information on the extent to which the planned geothermal heat pump will exceed the building energy efficiency standards. The geothermal heat pump industry has asked that an Alternative Calculation Method compliance option, or new set of modeling rules specific to geothermal heat pumps, be created to accurately estimate the energy consumption of a geothermal heat pump, allowing comparison to conventional heating, ventilation, and air conditioning systems. While many in the industry have successfully adapted the Energy Commission-approved compliance models for geothermal heat pumps, an Alternative Calculation Method compliance option could greatly improve the accuracy for modeling this technology.

The Energy Commission staff suggests that the first step to revising compliance models would be to develop new modeling rules for compliance with building standards, then to develop protocols for design engineers to verify the energy consumption of the geothermal heat pump. Energy Commission staff has indicated the Warren-Alquist Act (Public Resources Code 25402.1[b]) requires the geothermal heat pump industry to develop a compliance option for any technology that is not explicitly required in the standards. Historically, compliance option applications from industry have taken a year or more to review and approve. In the interim, staff suggests that site design engineers verify proper installation and confirm the efficiency of geothermal heat pump ground loops and all above-ground device installations, and that the geothermal heat pump industry develop protocol for site inspection by design engineers.

The geothermal heat pump industry disagrees with the proposed solution and the premise that responsibility for development of a compliance option lies with industry. Given the potential benefits of geothermal heat pumps, the industry suggests that the Energy Commission take the lead in developing an Alternative Calculation Method compliance option. The industry suggests that utilities and the Energy Commission work together with it to make corrections or provide new rule sets[1] to the *Building Energy Efficiency Standards.*

Other Regulatory Barriers

Additional barriers are local permitting inconsistencies and fee schedules. The California Department of Water Resources is responsible for developing minimum statewide standards for construction, maintenance, abandonment, and destruction of geothermal heat exchange wells (closed-loop geothermal heat pumps), and recommending them to the State Water Resources Control Board for adoption into a statewide model ordinance. By statute, the standards are focused on preventing contamination of the groundwater aquifers and do not address other potential permitting considerations. Local jurisdictions are required to adopt local ordinances that meet or exceed the statewide standards. According to a recent

[1] A rule set refers to the complex description that a building design modeler must follow to appropriately model a specific technology (such as geothermal heat pumps) in a building design with approved compliance models.

survey by the Department of Water Resources, most local jurisdictions use the Department's 1999 Draft Geothermal Heat Exchange Well Standards in permitting closed-loop geothermal heat pumps. However, there is reportedly widespread confusion and frustration both in the geothermal heat pump industry and in local permitting agencies with the standards remaining as draft.

The Department of Water Resources is currently updating the Draft Geothermal Heat Exchange Well Standards, with the intent of finalizing and presenting to the State Water Resources Control Board for adoption into a Model Ordinance. The Department of Water Resources' current effort is largely motivated by an expressed desire among industry and local enforcing agencies for adoption of statewide minimum standards.

Local jurisdictions are ultimately responsible for permitting and establishing fee schedules. Fee schedules vary significantly throughout the state. Based on one survey, fees ranged from $0 to over $4,000, indicating large variability across the state in local permitting processes for geothermal heat pump technologies.

Permitting open-loop geothermal heat pump systems requires navigation of a complex regulatory framework. Regulations at the federal, state, and/or local level may all be involved if the proposed systems include surface or underground aquifers or affect a navigable body of water. The process can be ambiguous since there are no definitive requirements or regulations from any central state or federal agency.

Industry recommends using a more comprehensive approach to geothermal heat pump permitting, to bring about more consistent fee schedules. Industry proposes developing a new type of model ordinance that would encompass the entire geothermal heat pump system, and would focus on the entire scope of issues, instead of solely on groundwater protection to assist with both permitting and fee schedule issues.

Another concern for the industry is that the terminology "geothermal heat exchange well" used in the California Water Code for closed-loop geothermal heat pumps may give rise to confusion, since "well" is typically used to describe a hole or excavation used for extraction or injection of water (or oil/gas). Also, resolving the lack of publicly available well log data would be extremely useful to geothermal heat pump installations.

Cost and Accounting for Geothermal Heat Pump Benefits

High initial cost is another barrier to the widespread adoption of geothermal heat pump technology and the industry suggests that California's tiered electricity rates further increase operating cost. Tiered electricity rates are structured so that consumers pay a higher rate for electricity usage over a baseline amount each month. Although geothermal heat pumps reduce total energy use, compared to standard heating, ventilation, and air conditioning systems, these rates can be unfavorable to consumers using geothermal heat pumps because they are all electric and, therefore, consume more electricity annually than standard heating, ventilation, and air conditioning systems consuming both electricity and natural gas. This tiered structure, along with the relatively low price of natural gas, can lead

to a long payback period for geothermal heat pump systems. The industry proposes developing a special tiered rate for installed geothermal heat pumps.

The geothermal heat pump industry offers a unique solution to the high cost of installing ground loop portions of geothermal heat pump systems, suggesting utilities own the loops, lease the systems to homeowners, and recover the initial capital investment with on-bill repayment over the life of the ground loop. Industry stakeholders (or representatives) suggest that if a geothermal heat pump was considered a renewable resource, the utility could be granted Renewables Portfolio Standard "credit" for geothermal heat pump systems, making the option more attractive for utilities. Energy Commission staff notes that geothermal heat pump technologies do not generate electricity and therefore are not eligible for the Renewables Portfolio Standard. Public Resources Code Section 25740 states, "It is the intent of the Legislature in establishing [the RPS], **to increase the amount of electricity generated** from eligible renewable resources per year so that it equals 33 percent of total retail sales of electricity in California per year by December 31, 2020" (**emphasis added**). However, Energy Commission staff acknowledges that in circumstances where using geothermal heat pump technologies reduces electricity consumption, that reduction in retail electricity sales could reduce the amount of renewable generation required for a load serving entity to reach its Renewables Portfolio Standard target.

The geothermal heat pump industry is concerned that the possible greenhouse gas benefits of geothermal heat pump technologies are not adequately captured in the California Air Resources Board's cap-and-trade program. The Air Resources Board staff suggests that geothermal heat pumps already receive incentives within the program in circumstances where they reduce the electricity generation needs of a utility, thus reducing the utility's compliance obligation.

CHAPTER 1:
Introduction

California Public Resources Code Section 25228, added by Assembly Bill 2339 (Williams, Chapter 608, Statutes of 2012), required the California Energy Commission, in consultation with the California Public Utilities Commission, cities, counties, special districts, and other stakeholders, to evaluate policies to begin addressing barriers to the use of geothermal heat pump (GHP) and geothermal ground-loop technologies, and to include its evaluations and recommendations in the *2013 Integrated Energy Policy Report* (*IEPR*).[2]

In evaluating these policies and strategies, the statute required the Energy Commission to consider:

1. The quantitative benefits and costs to ratepayers specific to safer, more reliable, or less costly gas or electrical service and through greater energy efficiency, reduction of health and environmental impacts from air pollution, and reduction of greenhouse gas emissions related to electricity and natural gas production and use, through the use of GHP and geothermal ground loop technologies.
2. The existing statutory and permit requirements that affect the use of GHPs and geothermal ground-loop technologies and any other existing legal impediments to the use of GHP and geothermal ground-loop technologies.
3. The effect of the use of the GHP and geothermal ground loop technologies on achieving the state's goals under the California Global Warming Solutions Act of 2006 (Health & Safety Code, § 38500 et seq.) and achieving the state's energy efficiency goals.

On March 7, 2013, the Energy Commission posted the *2013 IEPR Scoping Order*[3] identifying topics for the *2013 IEPR*, including the "evaluation of geothermal heat pump/ground loop technology barriers and strategies (as required by AB 2339)."

As part of the *2013 IEPR* proceeding, the Energy Commission held a workshop on March 21, 2013,[4] to solicit stakeholder feedback and gain a better understanding of industry's perspective on existing barriers to GHP technologies. After the workshop, the Energy Commission convened a staff working group composed of industry representatives, other state agencies, cities, counties, and interested parties to further evaluate current policies. The staff working group met on April 11, and 25, and May 30, 2013. Prior to these meetings, the

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2 California Energy Commission. 2013. *2013 Integrated Energy Policy Report.* Publication Number: CEC-100-2013-001-CMF. http://www.energy.ca.gov/2013_energypolicy/.

3 http://www.energy.ca.gov/2013_energypolicy/documents/2013-03-07_scoping_order_2013_IEPR.pdf.

4 http://www.energy.ca.gov/2013_energypolicy/documents/#03212013.

Energy Commission staff prepared and released a draft working group document as a starting point to help solicit feedback from interested stakeholders.[5]

This paper reflects input from the workshop and subsequent working group meetings as part of the Energy Commission's efforts to address AB 2339. However, the GHP industry views detailed within the paper do not necessarily represent the opinions of all working group members nor the views of the Energy Commission. The paper is not intended to be an exact record of the discussions that took place in the working group, but generally reflects topics covered and some subsequent analysis by Energy Commission staff. This paper provides additional detail to the high-level discussion and recommendations put forward in the *2013 IEPR* on GHP technologies.

What Is a Geothermal Heat Pump?

GHPs have existed for more than 50 years in the United States. These pumps exchange heat with the ground, which stays at a relatively constant temperature throughout the year, and use the heat-exchange to heat and cool buildings, optionally providing domestic hot water as well. GHP systems have a variety of configurations based on customer specifications, cost, and the surrounding environment. System designs include a wide range of industrial, commercial, and residential applications. GHPs typically result in significant energy efficiency gains over conventional building space conditioning and domestic hot water and have proven to work well with other renewable resource applications, such as photovoltaic systems and solar hot water. There are many types of installations, but most fall into a few categories described below.

Open-loop systems generally take water from the existing environment, put it through a heat exchange, and return the (typically warmer) water to the environment. Open-loop systems can also include effluent[6], as opposed to fresh water. In many instances recreational pools, nearby lakes, rivers, streams, and other aquifers are used as the basis for an open-loop GHP. A simplistic example would be to extract water from a lake at the surface, pump it through a heat exchanger connected to the building HVAC or domestic hot water system, and return it warmed or cooled to the bottom of the lake.

Closed-loop systems use a working fluid, typically water mixed with glycol (some systems also use refrigerant), to exchange heat with the surrounding environment, but this working fluid stays within the system. These systems fall into two subcategories: vertical loops and horizontal loops. **Vertical loop** systems use a drilling rig to bore holes straight down into the ground, typically between 150 and 300 feet, depending on the amount of cooling needed

5http://www.energy.ca.gov/2013_energypolicy/documents/working_group_2339/background_materials/

6 Effluent is something that flows out or forth, such as a stream flowing out of a lake or the outflow of a sewer, storage tank, irrigation canal, or other channel.

and the geologic formations (including aquifers) in the area. For vertical loop systems, the boreholes are typically filled with a groutlike substance after installation of the lines. From a performance perspective, the grout ensures continuous thermal contact between the heat exchange pipe and the ground as well as providing a secure support for the loop-system itself. From a public health and safety perspective, the grout renders the borehole safe from accidents, prevents the cross-contamination of underground aquifers (of which there may be several), and protects underground aquifers from contamination from above-ground water use (which may include pesticides and other poisons). While vertical loop installations go down, **horizontal loop** installations are buried about 10 feet underground over a large area. For example, a commercial building installation may place the ground loops of a horizontal system under an adjoining parking lot. A horizontal loop system may be straight piping or coiled pipe; the latter is sometimes referred to as a *slinky*. Closed-loop horizontal systems are also used for heat exchange with standing bodies of water, such as a nearby lake, with the coils being typically floated under the surface of the lake (even to the bottom).

All GHPs have several components in common. Interior heat exchangers are necessary to make use of the heating or cooling capacity of the loop field. These interior heat exchangers include heating or cooling for the air handling equipment for space conditioning and optionally the hot water storage tank for domestic hot water. The main system pump moves the working fluid from the loop field to the interior heat exchangers and back again. A more efficient heat exchange can be accomplished by using a refrigerant expansion heat exchange system in connection with the working fluid of the loop field. This can be beneficial in larger buildings with multiple conditioning zones. Each zone can be independently controlled for comfort, while still using a common GHP system to heat or cool; however, such an arrangement requires multiple compressors with a more sophisticated control system.

Below is a discussion of barriers and proposed solutions to help advance the use of GHPs in California. In many cases, industry representatives and Energy Commission staff did not agree on how to address the barriers raised; therefore, in the interest of transparency, Energy Commission staff presents the GHP industry proposals, as well as Energy Commission staff perspective.

CHAPTER 2:

Barriers to the Use of Geothermal Heat Pumps

Modeling Compliance With the *California Building Energy Efficiency Standards*

The *California Building Energy Efficiency Standards* require that most buildings be modeled to demonstrate compliance tradeoffs that are allowed within the standards. Energy Commission staff and the GHP industry generally agree that these models do not accurately represent the efficiency of GHP systems. This creates an unintended barrier to the industry because the model does not sufficiently estimate GHP energy consumption to allow for direct comparison to the energy consumption of conventional heating, ventilation, and air conditioning (HVAC) systems.

This unintentional barrier affects the industry in several ways. Utility rebate programs generally require prospective building owners to demonstrate that their buildings can qualify for the program and accept the efficiency measures prescribed by the program. This is most often accomplished by modeling the building with Energy Commission-approved compliance models. Therefore, building owners proposing to install a GHP may not qualify for a utility rebate simply because the model does not represent GHP well, or sometimes at all. Furthermore, to be eligible for rebates, GHP installation in the planning phase must demonstrate compliance with the *Building Energy Efficiency Standards*, as well as to what extent the GHP (and the rest of the building) will exceed the standards. This can be difficult using the currently approved compliance models. In addition to compliance modeling, field verification is often required for energy efficiency measures that exceed standard design practice. Without an Alternative Calculation Method (ACM)[7] – new modeling rules specific to GHPs – a verification system for HERS raters cannot be developed. Local jurisdictions with permit authority have been allowing GHP advocates to run parallel building energy models that do a better job of predicting GHP efficiencies – but are not approved compliance models – and coupling those results with the Energy Commission-approved compliance models. As an interim measure, some in the GHP industry suggest using the same HERS procedure for GHPs that the Energy Commission has already approved for the Daikin Altherma Heat Pump systems.[8]

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7 *2013 California Building Energy Efficiency Standards*, (Title 24, Part 1), Section 10-109(c)(2).

8 Dave Ware, California Energy Commission, *Final Evaluation Report, Proposed Compliance Option For Altherma Air-To-Water Source Heat Pump For The Residential Energy Efficiency Standards,* February 2012, Publication Number CEC-400-2011-010-SD.

To date, many in the GHP industry have successfully adapted the Energy Commission-approved compliance models for GHP. However, developing an ACM could greatly improve the accuracy for modeling this technology. For example, an ACM could standardize and improve current calculation methods to include soil water/moisture migration – the largest heat transfer mechanism – soil diffusivity, precipitation, known aquifer data, and other water sources. Also, an ACM could potentially be developed to include the combination of providing both domestic hot water and space conditioning, another aspect of GHPs that are currently not well captured.

Energy Commission Staff Perspective on ACM

As discussed in an Energy Commission staff presentation at the March 21, 2013, workshop,[9] modeling GHPs under *Building Energy Efficiency Standards* requirements can be revised in two phases. The first phase is to develop new modeling rules for compliance with building standards; the second is to develop protocols for design engineers to verify the energy consumption of the GHP.

Under the Warren-Alquist Act, industry is required to develop a compliance option for any technology that is not explicitly required (as a mandatory or prescriptive measure) in the *Building Energy Efficiency Standards*. Under Public Resources Code 25402.1, industry representatives, not Energy Commission staff, must undertake this task. Public Resources Code 25402.1(b), states (**emphasis added**):

> Establish a formal process for certification of compliance options for new products, materials, and calculation methods, which provides for adequate technical and public review to ensure accurate, equitable, and timely evaluation of certification applications. **Proponents filing applications for new products, materials, and calculation methods shall provide all information needed** to evaluate the application that is required by the commission. The commission shall publish annually the results of its certification decisions and instructions to users and local building officials concerning requirements for showing compliance with the building standards for new products, materials, or calculation methods. **The commission may charge and collect a reasonable fee** from applicants to cover the costs [of reviewing the information developed by the proponent] under this subdivision …

Developing an ACM will require:

- A lengthy review time at the Energy Commission, as well as development of an extensive staff report.

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9 Rob Hudler, California Energy Commission, "Ground Source Heat Pump, Current Treatment in Energy Compliance and the Pathway to Including GSHP in Title 24 Energy Calculations," March 21, 2013, Presentation at the Staff Workshop on Assembly Bill 2339 Requirements Policies to Overcome Barriers to the Use of Geothermal Heat Pump and Ground Loop Technologies. http://www.energy.ca.gov/2013_energypolicy/documents/2013-03-21_workshop/presentations/Ground_Source_Heat_Pump.pdf

- Development and verification of the new software program specific to GHP that can be incorporated into the California Building Code.
- Validation of many technical barriers and overcoming them.
- Site verification (test bore/well data are critical).

Historically, the Energy Commission has taken a year or more to review and approve compliance option applications from industry. In the interim, Energy Commission staff suggests that a site design engineer verify proper installation and confirm the energy efficiency of GHP ground loop(s) and all associated above-ground device installations. Energy Commission staff also suggest that the GHP industry develop a protocol for site inspection by design engineers. This protocol should:

- Use an existing rules set in computer modeling tools.
- Allow the design engineer to make the final decision on site acceptance.
- Use International Ground Source Heat Pump Association or other existing standards as a minimum standard of care as consumer protection from engineers or contractors who may not have appropriate experience.
- Require test bores be taken, per the American Society of Heating, Refrigerating and Air Conditioning Engineers, before designing and constructing closed-loop geothermal fields.

GHP Industry ACM Proposal

The GHP industry disagrees with the proposed solution and the premise that responsibility for development of a compliance option lies with industry. The GHP industry comments and recommendations below reflect its input through the GHP working group but are not supported by Energy Commission staff.

Given the potential benefits of GHPs, the GHP industry believes the Energy Commission should take the lead in removing internal barriers to GHP use and lead the development of an ACM in particular. In working group meetings and written comments, industry representatives raised the following concerns:

- The Seasonal Energy Efficiency Ratio (SEER)[10] and "equivalent" Energy Efficiency Ratio (EER)[11] rule set used to model the efficiency of water source equipment as air

10 The efficiency of air conditioners is often rated by the **Seasonal Energy Efficiency Ratio** (SEER), which is defined by the Air Conditioning, Heating and Refrigeration Institute in its standard ARI 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

11 The **Energy Efficiency Ratio** (EER) of a particular cooling device is the ratio of output cooling (in British thermal units [BTU] per hour) to input electrical power (in watts) at a given operating point. EER is generally calculated using a 95 °F outside temp and an inside (actually return air) temperature of 80 °F and 50 percent relative humidity. The EER is a more realistic measurement of energy efficiency than SEER in warmer climates due to the high demand and higher cost of peak hour electricity.

source equipment in the ACM is incorrect. HVAC equipment is modeled based on nameplate efficiencies as listed in the Energy Commission Certified Appliance Directory. System efficiencies are not usually modeled, except to get credit for a higher system EER, which requires site HERS verification.

- Designers have been asking the Energy Commission for a method to directly input coefficient of performance (COP)[12] and EER in the Energy Commission-approved compliance software since 1997.[13]
- The *Building Energy Efficiency Standards,* Section 112, lists mandatory requirements for various types of space conditioning equipment. This equipment may be installed only in California if it meets the efficiency requirements listed in Tables 112-A through 112-M of the standards. All of these required efficiencies are stated in terms of COP, EER, and Integrated Part Load Value (IPLV).[14] Thus, the Energy Commission requires the specification of efficiencies in COP and EER but does not allow direct modeling of the COPs and EER.
- The ACM does not prescribe rule sets for modeling GHP systems.
- The current Title 24 compliance tools do not support the objectives of Assembly Bill 32, the Global Warming Solutions Act of 2006 (Núñez, Chapter 488, Statutes of 2006); Assembly Bill 758 (Skinner, Chapter 470, Statutes of 2009) program to advance

12 The **coefficient of performance** (COP) of a cooling device is unitless because the numerator and denominator are expressed in the same units. The EER uses mixed units, so it is obtained by multiplying the COP by the conversion factor from BTU per hour to watts: EER = 3.41214 × COP (see BTU). The SEER is also the COP expressed in BTU per watt-hour, but instead of being evaluated at a single operating condition, it represents the expected overall performance for a typical year's weather in a given location.

13 Written comments by Mr. Pat Split, a member of the AB 2339 GHP Working Group.

14 **Integrated Part Load Value** (IPLV), like the EER rating, was developed by the Air-Conditioning and Refrigeration Institute (ARI). (In 1998, the ARI released a revised standard, ARI 550/590-98, to cover IPLV.) Unlike the EER, the IPLV measures the efficiency of air conditioners under a variety of conditions, when the unit is operating at 25, 50, 75, and 100 percent of capacity and at different temperatures.

energy efficiency in existing buildings;[15] zero-net-energy (ZNE) goals;[16] RPS goals for 2020;[17] and Proposition 39-funded projects.[18]

- The current methods used by Energy Commission-approved software providers to model GHP systems do not model homes and are incorrect for nonresidential buildings.

GHP industry representatives believe that for California to meet its energy goals for both residential and commercial buildings, more precise representation of GHP system efficiency in various building types and geographical locations is required to demonstrate savings to building owners, utilities, and the Energy Commission.

To accomplish this, industry representatives suggest that industry, utilities, and the Energy Commission need to come together to swiftly make corrections or provide new rules sets to the *Building Energy Efficiency Standards*. The industry suggests that inadequacy of the current rule sets in the ACM and lack of checks and balances in current compliance software outputs require immediate attention. Further, industry proposes that modeling, data collection, and a compilation of current modeling techniques by other widely accepted modeling tools should be reviewed and considered for adoption for modeling GHPs systems against other mechanical systems.

Industry representatives also suggest that the prevalence of "rule set methodology[19]" presented by staff in the March 21, 2013, workshop, acknowledged by staff since the workshop and discussed by non-GHP industry members in Commission hearings, strongly

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15 The Energy Commission staff comment: The *Building Energy Efficiency Standards* represent a significant and successful measure to reduce greenhouse gas emissions within California that represent 40 to 60 percent of state and local inventories. While the modeling requirements do not represent GHPs well, the standards are very successful in supporting the AB 32 goals, ZNE implementation goals, and AB 758 goals.

16 Energy Commission staff comment: The Energy Commission has demonstrated that the ZNE goals can be attained and that the *2013 Building Energy Efficiency Standards* are a major milestone in that achievement. While GHPs can contribute to the ZNE goals, it is not the only technology that holds this promise, nor are the ZNE goals dependent upon this or any other single technology.

17 Energy Commission staff comment: RPS goals are not met with nongenerating renewable resources such as GHPs.

18 Industry representatives were concerned that *Building Energy Efficiency Standards* compliance models would be used to evaluate eligibility of energy efficiency projects for funding with money from Proposition 39. The Energy Commission has since adopted funding guidelines and does not require use of the *Building Energy Efficiency Standards* compliance models to evaluate eligibility for Proposition 39 funding.

19 The development of a rule set methodology is the main goal of an ACM. It describes in detail how a particular technology can be modeled with existing or augmented building energy models to demonstrate compliance with the *Building Energy Efficiency Standards*.

support their assertion that the Energy Commission-approved compliance models need immediate revision.

Below are specific recommendations from industry representatives and comments explaining why Energy Commission staff disagrees.

1. The industry suggests that the Energy Commission, in cooperation with the California Public Utilities Commission and CaliforniaGeo[20], should develop new rule sets to correct current shortcomings in the *Building Energy Efficiency Standards* and the ACM relevant to GHP systems.

   Energy Commission staff response: The Energy Commission is precluded from this activity both by restriction of law (Public Resources Code 25402.1, 25402[a] [b]) and by practical staffing restriction.

2. The industry suggests that the Energy Commission recommend that GHP be placed at the highest priority for development on the investor-owned utility Code and Standards Enhancement (CASE) report agenda.

   Energy Commission staff response: The Energy Commission cannot request that investor-owned utilities investigate specific technologies for their CASE reports. Investor-owned utilities and all other parties provide CASE reports to the Energy Commission for consideration in the update to the *Building Energy Efficiency Standards*. Energy Commission staff recommends that the GHP industry provide a CASE report or petition investor-owned utilities to provide a CASE report regarding GHP in California.

3. The industry suggests that the Energy Commission allow other industry standard software tools for modeling GHP systems against the baseline mechanical system, as defined in the ACM, for overall system efficiency for meeting CALGreen[21], Ygrene[22], LEED[23], and eligibility for utility rebates and incentives. Focusing on thousand British thermal units (kBTU) per square foot should be considered in lieu of "percentage better than Title 24."

   Energy Commission staff response: The Energy Commission does not have authority to dictate compliance strategies or requirements for CALGreen, Ygrene, LEED or eligibility for utility rebates or incentives.

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20 CaliforniaGeo is an industry lobby for the GHP industry.

21 CALGreen refers to the California Building Code Part 11 Green Building Code Standards.

22 Ygrene refers to Ygrene Energy Fund who provide funding for energy efficiency projects within an establish area.

23 LEED refers to the Leadership in Energy & Environmental Design who have a long established checklist style system for designing and building better energy efficient and environmentally friendly buildings.

4. The industry suggests that the Energy Commission work with the GHP industry to develop a reasonable prescriptive approach to GHP compliance, coupled with a certificate of compliance for both the ground heat exchanger and GHP. This shall be signed off by the engineer of record. For residential projects, the installing mechanical contractor may sign off on the certification of compliance if there is no engineer of record.

   Energy Commission staff response: The Energy Commission staff encourages the GHP industry to propose protocols for the GHP design engineer to use for verification of the efficiency of a GHP on site after construction.

5. The industry suggests that the Energy Commission develop Title 24 compliance tools to support AB 32 objectives.

   Energy Commission staff response: Energy Commission staff encourages GHP industry representatives to submit an ACM application to the Energy Commission consistent with the *2013 Building Energy Efficiency Standards*, Section 10-109(c)(2).

Permitting and Fee Schedules

Per the California Water Code[24], the California Department of Water Resources (DWR) is responsible for developing minimum statewide standards for construction, maintenance, abandonment, and destruction of geothermal heat exchange wells (closed-loop GHPs). By statute[25], these standards are focused on preventing contamination of the groundwater aquifers and do not address other potential permitting considerations. The Statute includes the following:

- Defines "geothermal heat exchange well" as any uncased artificial excavation that uses the heat exchange capacity of the earth for heating and cooling, in which the ambient ground temperature is 30 degrees Celsius (86 degrees Fahrenheit) or less, and which uses a closed loop fluid system to prevent the discharge or escape of its fluid into surrounding aquifers or other geologic formations. The statute requires DWR to develop and recommended minimum standards for the construction, maintenance, abandonment, or destruction of geothermal heat exchange wells to prevent closed-loop GHPs from becoming conduits for contamination entering the groundwater aquifer by July 1, 1997 and to submit to the State Water Resources Control Board (SWRCB).

24 Water Code section 13000 et seq. (added by Stats.1996, c. 581 (A.B.2334))

25 These Standards are in response to AB 2334 (Cortese, Chapter 581, Statues of 1996) which amended Sections13700, 13701, 13750.5, 13751, and 13752, added Sections 13713 and 13800.5 and repealed Section 13750 of the California Water Code

- Authorizes a local agency with authority over geothermal heat exchange wells to adopt temporary regulations applicable to geothermal heat exchange wells that the local agency determines to be consistent with the intent of existing DWR standards.
- Requires the SWRCB, by January 1, 1998, to adopt a model geothermal heat exchange bore and well ordinance to implement DWR's recommended standards. SWRCB is required to circulate the model ordinance to all cities and counties.
- Requires each county, city, or water agency where appropriate, by April 1, 1998, to adopt a geothermal heat exchange well ordinance that meets or exceeds the recommended standards developed by DWR. If an appropriate local agency fails to adopt such an ordinance, the model ordinance adopted by the SWRCB shall take effect on May 1, 1998, and shall be enforced by the county or city.

In April 1999, DWR published Draft Geothermal Heat Exchange Well (GHEW) Standards. The draft standards were to be included in a revision of Bulletin 74-81/74-90; however, the April 1999 Draft Geothermal Heat Exchange Well Standards were not finalized or adopted into a Model Ordinance. Most local jurisdictions report using the 1999 Draft Geothermal Heat Exchange Well Standards for permitting GHPs.[26] However, the fact that the Standards remain as Draft has been a source of confusion and frustration among industry and local permitting agencies alike.

In 2012, DWR began a process of updating the 1999 Draft Geothermal Heat Exchange Well Standards, with the intent of finalizing and presenting recommended minimum standards to the SWRCB for adoption. DWR's current effort is largely motivated by an expressed desire among industry and local enforcing agencies for adoption of statewide minimum standards. DWR recently convened a Stakeholder Advisory Group with 18 representatives from industry, agencies, and others to review a working draft of the Standards. The group met seven times over five months, and completed their review in January. DWR is currently revising the draft in consideration of the Group's input, with plans to issue a public review draft prior to finalizing and presenting to the SWRCB for adoption into a Model Ordinance. Per the Water Code, local jurisdictions will be required to adopt Local Ordinances that meet or exceed the Model Ordinance.

Terminology

One significant concern to the GHP industry is that the terminology "geothermal heat exchange well" in the statute may give rise to confusion. Industry is particularly concerned over the term "well" as opposed to "borehole." Whereas "well" is typically used to describe a hole or excavation used for extraction or injection of water (or oil/gas), "borehole" typically connotes a hole that is drilled for purposes other than extraction/injection. Therefore, the word "borehole" seems more appropriate for the closed-loop GHPs which are filled with grout following the installation of the heat exchange fluid circulating pipe. Although there is currently no single terminology consistently used throughout the

26 California Department of Water Resources phone survey of Local Enforcing Agencies, 2013

industry[27] for closed-loop GHPs, industry representatives in California are working toward one.

DWR authority is tied to the Water Code and it's definitions. To address industry's concerns to the extent possible within the standards, DWR has referred to them using the acronum GHEW or "borehole," throughout the draft Standards.

Fee Schedules

Local jurisdiction fee schedules vary greatly—a recent study[28] showed that they range from $0 to over $4,000. Local jurisdictions charge either: 1) per well, 2) per site, 3) per hour, or 4) a combination of one or more of the above. Most local jurisdictions have little or no experience with GHPs and permit them on an ad hoc basis, or treat them as if they were water wells. The authority to charge a fee schedule is left exclusively with the local jurisdiction.

GHP Industry Recommendation for Permitting

Industry recommends using a more comprehensive approach to closed-loop GHP permitting, to bring about a more consistent fee schedule. Industry proposes developing a new type of model ordinance that would encompass the entire GHP system, and would focus on the entire scope of issues, instead of solely on groundwater protection. Industry recommends that this new ordinance be based on formalized standards developed through a collaboration between local International Code Council Chapters, regional water quality boards, the California Building Standards Commission, the California Department of Housing and Community Development, the Energy Commission, and industry representatives.

Energy Commission Staff Response: Energy Commission staff intends to participate in the DWR process to develop these standards and ensure that they are consistent with Energy Commission policy and Building Energy Efficiency Standards. Additionally, Energy Commission staff supports the industry position on the use of appropriate terminology.

Permitting of Open-Loop Systems

Permitting open-loop GHP systems requires navigation of a complex regulatory framework. In California, there are many agencies (federal, state, and local) that may have authority over open-loop systems, especially if those systems include surface or underground aquifers, wastewater, seawater, or in any way affect a navigable body of water. If an open-loop system includes re-injection into a public wastewater system, additional authorities

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27 DWR conducted a survey of other states standards and found little consistency in terminology. There were roughly twenty-five variations in terminology for vertical closed loop systems alone; of those, half (12) include the term "well" and the other half (13) use terms like "borehole," "drillhole," "hole," or "system."

28 Dennis Murphy, GroundSource Geo, Inc., "*Project Negatherm for Ground Source Heat Pumps: Improving the Geothermal Borehole Drilling Environment in California,*" prepared for the California Energy Commission, July 2011, Publication Number CEC-500-2011-025.

may be involved. The following table includes a short list of federal, state, and local agencies that may have authority over open-loop systems. While the list is by no means comprehensive, it illustrates that a large number of regulators may have authority over an open-loop GHP system.

The permitting process for an open-loop GHP installation can be substantial and often ambiguous, since there are no definitive requirements or regulations from any central federal or state agency; indeed, if such regulations existed, they would cross the authorities of multiple federal, state, and local agencies. The majority of these issues lie with agencies concerned with water quality and water use permits, an area outside the authority of the Energy Commission.

Energy Commission staff response: While the Energy Commission does have a role to play in an interagency effort to develop a streamlined approach to permitting open-loop GHPs, it is not a lead role.

Table 1: Federal, State, and Local Agencies With Possible Authority Over Open-Loop Geothermal Heat Pump Systems

Agency	Area of Authority
U.S. Environmental Protection Agency	• Any Class V underground injection well is required to submit an inventory form. • Extraction limits in accordance with the National Water Quality State of Being requirements in keeping with riparian or appropriation rights. • Larger projects may be required to respond to the National Environmental Policy Act requirements.
U.S. Army Corps of Engineers	Authority over all navigable waters including lakes, rivers and streams.
U.S. Department of Interior • Bureau of Reclamation • Bureau of Land Management • Bureau of Ocean Energy Management • U.S. Fish and Wildlife Services	• Water Conservation Act, implemented through local jurisdictions. • If the project is on federal lands. • If the project affects wetlands or coastal zones. • If the project will affect wildlife on the endangered species list. Most of these authorities are implemented through state or local departments, but some may be implemented through the Interior Department Bureau(s) directly.
State Water Resources Control Board	• Authority over California surface water quality. • Authority over California surface water use permits.
California Coastal Commission	Has permit authority for coastal development projects or projects within the coastal zone.
California Energy Commission	California Building Energy Efficiency Standards
California Building Standards Commission	California Building Standards and Green Building Code
California Department of Housing and Community Development	Affordable housing requirements and residential standards development.
Local Building Departments	Permitting authority for buildings and construction.
Local Planning Departments	Authority over zoning requirements and limitations.
Local Regional Water Quality Control Boards	Permit authority over wastewater discharge.
Local Counties, Cities, and Towns	Local ordinances may affect the permitting of open-loop systems.

Source: California Energy Commission Staff

Installation Practices

The experience and expertise of a GHP installer can greatly affect the performance of the GHP. Typically, the GHPs that continue to perform per specification for 10, 20, or 50 years or more are designed and installed by trained installers and experienced companies. Industry based manuals are available for the installation of entire GHP systems. The International Ground Source Heat Pump Association (IGHPA) offers training, certification, and manuals on the design, construction, and testing of GHPs. Formalizing these best practices as standards can bring that level of expertise to installation companies throughout California. Systems that fail or are underperforming according to original designs can typically be traced back to undertrained and inexperienced installation companies. With the advent of the IGHPA standards, the industry as a whole seeks to eliminate these failures.

Well Log Data

Well logging, also known as borehole logging, is the practice of making a detailed record (or well log) of the geologic formations penetrated by a borehole. The log may be based either on visual inspection of samples brought to the surface (geological logs) or on physical measurements made by instruments lowered into the hole (geophysical logs). Well logging can be done during any phase of the history of a well: drilling, completing, producing, or abandoning. Well logging is performed in boreholes drilled for oil and gas, groundwater, and mineral and geothermal exploration, and is part of environmental and geotechnical studies. Such data is extremely useful in designing GHP installations.

Current California law considers water well information private information. Reports submitted on water wells, monitoring wells, or cathodic protection wells are subject to California Water Code Section 13752, while reports submitted on geothermal heat exchange wells and boreholes are open for public inspection.

While California collects well logs systematically, DWR cannot make the water well, cathodic protection, or monitoring well data publicly available because they are considered confidential. Other states (Missouri, New Jersey, Idaho, Washington, and Oregon) collect well log data on a state level and generally make them publicly available via a Web portal.

The GHP industry would like the Energy Commission to work with DWR to investigate the feasibility of making all well completion reports for GHPs available on a central website for public access. This could be implemented with the new Geothermal Heat Exchange Well Standards.

Energy Commission staff response: Energy Commission staff suggests that this is outside the Energy Commission's purview.

Tiered Electricity Rates

In addition to permitting and installation challenges, cost can pose a barrier to the use of GHP technologies in California. This can be partly attributed to the electricity rate structure in California, under which residential customers pay a higher rate for electricity use above a baseline level each month. The baseline quantity is the amount of energy that is intended to satisfy a substantial portion of the energy needs of the average customer for space conditioning, water heating, lighting, refrigeration, and cooking. As a customer's energy use moves above the baseline quantity, the price paid per kWh increases.

This tiered rate structure penalizes consumers using GHP technologies because GHPs are all electric, and, therefore, consume more electricity annually than a standard HVAC system that uses both natural gas and electricity. While GHPs eliminate natural gas consumption and reduce the total annual BTU per hour consumed as compared to the standard split gas-electric system, the GHP consumer may pay a higher electricity rate due to increased electricity consumption. The tiered rate structure, combined with natural gas prices that are relatively low, can lead to a long payback period for GHP systems.

The GHP industry suggests that creating a special tiered rate for installed GHPs would help to reduce—or even eliminate—this barrier.

Energy Commission staff response: California electricity rate design is a complex process that is the purview of the California Public Utilities Commission for investor-owned utilities and the purview of individual governing boards for the publicly owned utilities. To further explore this issue, the Energy Commission staff suggests that the GHP industry participate in the California Public Utilities Commission's rate reform proceeding (R.12-06-13)[29] and, as appropriate, to engage the Governing Boards of the publicly owned utilities.

Utility-Based Loop Lease Programs

The GHP industry suggested that one possible solution to the high cost of installing the ground loop portions of GHP systems is for utilities to own the loops (and possibly more of the system), lease the system to homeowners, and recover the initial capital investment with on-bill repayment over the life of the ground loop (typically 50 years). The concept for a utility-based loop lease program begins with the idea that a utility would install, maintain, and own the GHP loop-piping network for the heat pump system, while a customer would own and maintain the heat pump itself. The utility would charge customers either a monthly fee or a usage charge based on a BTU meter reading.

29 http://www.cpuc.ca.gov/NR/rdonlyres/66CCE840-F464-42F5-8B6A-D9F0FC649F67/0/Integrated_ResidentialRateReform.pdf.

The on-bill repayment charter[30] requires utilities to provide on-bill repayment methods to third parties only if the technology is included in the utility's rebate portfolio. GHP technologies are not currently eligible for investor-owned utility rebates or on-bill repayment.

The Plumas-Sierra Rural Electric Cooperative provides an example of how such a program could work to help advance GHP deployment. Plumas offers a 15-year, nontransferable, interest-free loan for GHP installations. The monthly payment is added to the customer's monthly electric bill, and the amount of the loan is based upon the size of the GHP loop installed. To date, more than 450 systems have been installed under the program.

Under the Plumas-Sierra program, the monthly payments for a 4-ton system would be $29.90 for a horizontal loop and $83.33 for a vertical bore field. As an incentive, a new 85-gallon water heater is offered free of charge. The addition of "de-super-heater[31]" waste heat capacity further reduces energy usage. Plumas-Sierra estimates a consumer will save $2,000 in annual heating energy costs when he or she installs GHP instead of using propane for heating.

Consideration of GHP as a Renewable Resource

The GHP industry has discussed at length whether GHP should be considered an energy efficiency measure, a renewable energy technology, or both. This distinction has implications for how the technology is treated in state energy policy.

The California Geothermal Heat Pump Association attributed to the CPUC: [32]

> *"A geothermal heat pump is a central heating or cooling system that pumps heat to or from the ground. It uses the earth as a heat source (in the winter) or a heat sink (in the summer). It could be* ***characterized as both a renewable distributed energy resource as well as an energy efficiency resource****, since it uses geothermal heat to reduce a building's electricity requirements."*

Moreover, the GHP industry points out that GHP systems are considered a renewable energy technology by the federal government. This allows the industry to qualify for federal tax credits and accelerated depreciation.

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30 On September 19, 2013, the California Public Utilities Commission (CPUC) approved a pilot on-bill repayment program that permits nonresidential customers of the state's large investor-owned utilities to obtain private capital for energy efficiency retrofits and distributed generation and demand response projects, with repayment made on the customer's utility bill. The on-bill repayment concept is further described in WSGR's *Innovations and Opportunities in Energy Efficiency Finance*, http://www.wsgr.com/publications/PDFsearch/WSGR-EE-Finance-White-Paper_13.pdf (May 2013).

31 *De-super-heating* is the process by which superheated steam is restored to its saturated state, or the temperature is reduced.

32 http://www.energy.ca.gov/2013_energypolicy/documents/2013-03-21_workshop/presentations/Barriers_to_Rapid_Wide_Spread_Deployment_of_GHP_Session_3-1.pdf.

Energy Commission staff response: Energy Commission staff treats GHP technology as an energy efficiency measure because it can reduce the total energy consumption at a building site, but does not directly produce power. This is analogous to the treatment of solar water heating technology. In circumstances where the amount of electricity consumed is reduced, it eliminates the need to produce and transmit energy from a distant power plant. This avoids power plant efficiency losses, transmission losses, and losses associated with power plant fuel extraction and delivery. In 2003, the state's first *Energy Action Plan* established the state's loading order, calling for electricity needs to be met first with increased energy efficiency and demand side resources, followed by renewable resources, and only then by clean conventional electricity supply. Similarly, in circumstances where the amount of natural gas consumption is reduced, fuel extraction and delivery are avoided.

RPS Eligibility

The GHP industry suggested that GHP should qualify towards the state's Renewables Portfolio Standard (RPS). For example, as part of a utility-based lease program proposal discussed above, the GHP industry suggested that the Energy Commission grant the utility RPS "credit" for GHP systems.

Energy Commission staff response: Energy Commission staff has pointed out that nongenerating energy efficiency measures such as GHPs and solar water heating are not eligible for the RPS. RPS compliance is evaluated based on the generation of electricity from eligible renewable energy resources compared to the total retail sales of a utility or other obligated entity. As stated in the Public Utilities Code 399.12(i), "*Renewables portfolio standard* means the specified percentage of electricity generated by eligible renewable energy resources that a retail seller or a local publicly owned electric utility is required to procure pursuant to this article." Nongenerating energy efficiency measures would be incapable of producing renewable electricity and could provide only a decrease in the retail load served by a utility.

Further, the law defines a renewable energy credit as "a certificate of proof associated with the generation of electricity from an eligible renewable energy resource, issued through the accounting system established by the Energy Commission under Section 399.25, that one unit of electricity was generated and delivered by an eligible renewable energy resource."[33] A renewable energy credit must also include all renewable and environmental attributes associated with the production of electricity from the eligible renewable energy resource, except for an emissions reduction credit issued pursuant to Section 40709 of the Health and Safety Code and any credits or payments associated with the reduction of solid waste and treatment benefits created by the utilization of biomass or biogas fuels."[34]

33 PUC 399.12(h)(1).

34 PUC 399.12(h)(2).

Energy Commission staff points out that while GHPs use a geothermal energy resource, they do not generate electricity and thus are not renewable electrical generating facilities and are not RPS-eligible renewable energy resources.

GHP Industry Proposal

The GHP industry put forward the following proposals related to accounting for GHP as a renewable resource.

1. The GHP industry has proposed that the Energy Commission evaluate the need for adding a "nongenerating renewable technology" definition to the RPS and suggest a path for RPS inclusion of nongenerating renewable technologies such as solar thermal and GHP loops.

   Energy Commission staff response: The Energy Commission staff notes that this definition would require a legislative change to the RPS program. Energy Commission staff also notes that all energy efficiency measures which reduce electricity consumption affect the RPS goals by lowering the total amount of necessary RPS-eligible generation needed to meet RPS requirements

2. The GHP industry has also proposed that the Energy Commission work with the California Public Utility Commission and California utilities to develop financial metrics and societal benefits to the inclusion of loops as a utility asset.

   Energy Commission staff response: Energy Commission staff defers to the California Public Utility Commission.

3. The GHP industry has additionally proposed that the Energy Commission work with the California Public Utility Commission, California utilities, and other stakeholders to develop a framework for creating a "One Million Geo Yards" program similar to the "One Million Solar Roofs" program, but quite different in that the primary financial incentives should come from utility-based loop ownership and financing programs and not direct public investment.

   Energy Commission staff response: While this is a laudable goal, the Energy Commission does not have sufficient staff or other resources to contribute to this endeavor.

Estimating Avoided Greenhouse Gas Emissions

In the February 29, 2012, Public Interest Energy Research staff workshop, Bill Glassley (California Geothermal Energy Collaborative) presented preliminary findings[35] on the

35 http://www.energy.ca.gov/research/notices/2012-02-29_workshop/presentations/Geothermal/Glassley-Asquith-Lance-Brown_Presentation.pdf.

energy and air emission reduction benefits from GHP deployment throughout California. He reported that:

- Energy use, per home, varies greatly among climate zones. If averaged together, the energy for HVAC per household would be reduced by 44 percent. The greatest savings in energy comes from climate zones dominated by heating loads.
- Total atmospheric emissions (carbon dioxide, nitrous oxide, and sulfur dioxide) correlate with energy use. If averaged together, the total emissions per household would be reduced by about 40 percent, nearly all of which is from reduction in carbon dioxide.

The Energy Commission currently uses time-dependent valuation calculations to estimate the upstream impact of energy efficiency measures for the *Building Energy Efficiency Standards* on an hourly basis. During the rulemaking phase for the *Building Energy Efficiency Standards*, the time-dependent valuation calculations are used to estimate the energy savings and associated greenhouse gas emission savings of the efficiency measures on an hourly basis over California as a whole. However, the current method would not be applicable to individual installations of GHPs (or any efficiency measure). While the energy savings estimated correspond to local climate zones within California, the estimated greenhouse gas savings apply to California as a whole. To predict the impacts on greenhouse gas emissions from a single installation of any efficiency measure would require knowledge of the hourly electric energy resource mix of the utility supplying that power; such an effort is currently impractical. Therefore, Energy Commission staff can estimate statewide greenhouse gas emission savings from predicted GHP installations, but not individual installations.

The GHP industry expressed interest in developing a protocol to recognize the possible greenhouse gas benefits of GHP technologies as part of the California Air Resources Board (ARB's) cap-and-trade program. The cap-and-trade program includes offset credits for greenhouse gas emission savings that meet regulatory criteria.[36] Offsets may be used by a regulated entity to meet compliance obligations under the cap-and-trade program.

Energy Commission staff response: ARB staff indicates that GHP technologies would not qualify for offsets from the cap and trade program because to the extent it reduces emissions, it would do so from a capped sector. Offsets can only be developed for emission sources from uncapped sectors. ARB staff reiterated that a GHP system already receives incentives through cap-and-trade because reductions in energy use result in a reduced cap and trade compliance obligation.

36 Sub-article 13, http://www.arb.ca.gov/cc/capandtrade/ctlinkqc.pdf.