

STATE OF CALIFORNIA - THE RESOURCES AGENCY  
BEFORE THE  
CALIFORNIA ENERGY COMMISSION (CEC)

California Energy Commission <b>DOCKETED</b> <b>13-IEP-1P</b>
TN # 2943 APR. 22 2013

In the matter of, )  
 ) Docket No. 13-IEP-1P  
 )  
 Preparation of the 2013 )  
 Integrated Energy Policy Report )  
 (2013 IEPR) )

**Staff Workshop on Assembly Bill 2339 Requirements  
Geothermal Heat Pump (GHP) Systems  
Potential for California**

California Energy Commission  
Hearing Room A  
1516 9th Street  
Sacramento, California

Thursday, March 21, 2013  
10:00 A.M.

Reported by:  
Barbara Little

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Joe Loyer, Mechanical Engineer

Also Present (\* Via WebEx)

Presenters

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Hazel Miranda, Senior Policy Advisor to Commissioner McAllister

Phil Henry, President of CaliforniaGeo - California Geothermal Heat Pump Association, Inc.

Joe Loyer, Mechanical Engineer, California Energy Commission

Lisa Meline, P.E., Meline Engineering Corporation, and CaliforniaGeo Chair

Steve Kavanaugh, Ph.D., Professor Emeritus of Mechanical Engineering, University of Alabama

Paul Bony, Director of Residential Market Development & Western Region Sales, ClimateMaster

Marc Hoeschele, Engineering Director, Davis Energy Group, Inc.

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Phil Henry, President of CaliforniaGeo - California Geothermal Heat Pump Association, Inc.

Rob Hudler, Energy Commission Specialist I, California Energy Commission

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## P R O C E E D I N G S

1  
2 MARCH 21, 2013 10:05 A.M.

3 MS. KOROSEC: Good morning, everyone. We're  
4 going to go ahead and get started. Today's workshop is  
5 being broadcast through our WebEx conferencing system  
6 and parties do need to be aware that you are being  
7 recorded.

8 We'll make an audio recording available on our  
9 website in a couple of days and we'll make a written  
10 transcript available in a couple of weeks.

11 We plan to break for lunch around noon. There's  
12 a list of restaurants within walking distance of the  
13 building on the table out in the foyer.

14 And we also plan to take a couple of short  
15 breaks in the afternoon.

16 We have four sections in today's agenda. We'll  
17 provide time for Q&A and public comments in each one.  
18 And in each of the sessions we'll take questions or  
19 comments first from those of you here in the room,  
20 followed by people who are participating on the WebEx,  
21 and then, finally, from the people who are phone-in,  
22 only.

23 When you're making comments or asking questions  
24 we ask that you please come up to the center podium and  
25 use the microphone so that we can make sure that people

1 participating remotely can hear you, or we do have a  
2 traveling microphone, too, if needed.

3           And, also, it's helpful if you can give our  
4 court reporter a business card after you're through  
5 speaking so we can make sure that your name and  
6 affiliation are correct in the transcript.

7           For WebEx participants, you can use the raised  
8 hand function to let our coordinator know that you have  
9 a question, and we'll open your line at the appropriate  
10 time.

11           And for those of you who are phone-in, only,  
12 we'll open all of the phone lines for questions or  
13 comments after we've taken the questions from the online  
14 participants.

15           Please state your name slowly and clearly so  
16 that we make sure we capture it in the record.

17           We're also accepting written comments on today's  
18 topics until close of business on April 12th. And the  
19 notice for today's workshop, which is on the table in  
20 the foyer, and also available on our website, explains  
21 the process for submitting documents to the IEPR docket.

22           Just some very brief context for today's  
23 workshop, every two years the Energy Commission  
24 publishes its Integrated Energy Policy Report, which is  
25 then submitted to the Governor and Legislature. The

1 recommendations in the report represent California's  
2 official energy policy and are meant to ensure reliable,  
3 affordable, and environmentally benign sources of energy  
4 for our citizens and to support the economy.

5 In 2012, Governor Brown signed Assembly Bill  
6 2339 into law, which requires the Energy Commission to  
7 evaluate barriers to deployment and use of geothermal  
8 heat pump and geothermal ground loop technologies,  
9 recommend strategies to overcome those barriers, and  
10 include the results in the 2013 Integrated Energy Policy  
11 Report.

12 So, with that brief introduction, I'll turn  
13 things over to Joe Loyer, our CEC staff member who's our  
14 organizer and our MC for today.

15 MR. LOYER: Now, is it working? Is that better?  
16 I'll try and -- oh, there it goes, okay.

17 Yeah, this is actually my first time using this  
18 mobile microphone here, so if I cut in and out, I  
19 apologize.

20 I am Joe Loyer, California Energy Commission.  
21 I'm a mechanical engineer here and I'm so far the first  
22 staff -- not the first staff. I'm the current staff,  
23 but we have many staff that have been involved with  
24 ground source heat pumps.

25 And we've been looking at them for quite a

1 number of years as part of our Zero Net Energy Building  
2 Code, at possibilities and how to incorporate them into  
3 code.

4 I think one of the things we want to say first  
5 off is welcome. Thank you for coming. It's a relief to  
6 see some people that are not going to be presenting  
7 today in the audience. Thank you very much.

8 And on the WebEx, thank you for tuning in, we  
9 very much appreciate it.

10 And we hope that this is going to be an  
11 insightful discussion, an opportunity to educate the  
12 staff, and to share technology, and positions, and maybe  
13 solutions.

14 One of the things that we need to recognize  
15 right now is that at the end of this workshop that's not  
16 the end. We are going to have a working group. And if  
17 you are here today, there is a sign-up sheet in the  
18 front that have an option to join that working group.

19 And the objectives of the working group are  
20 actually to help the Energy Commission produce policy  
21 reports.

22 Now, essentially, what will happen is the staff  
23 will work with the working group to produce  
24 recommendations to the Commission.

25 The Commissioners will then review it and decide

1 if these are going in the right direction, if this is  
2 supportable, if it's something the Energy Commission can  
3 do.

4 And more importantly, almost as importantly at  
5 least is, is it something that is going to be useful to  
6 the industry?

7 And so, that's why you should join the working  
8 group. If you have an interest in ground source heat  
9 pumps and seeing them folded into code, effectively, and  
10 seeing them used more effectively in California.

11 So, with that I'd like to turn it over to our  
12 first speaker for some introductory remarks, Sara Arce.

13 MS. ARCE: Can you hear me? My name is Sara.  
14 I'm actually with the Office of Assembly Member  
15 Williams. Good morning Commission staff, and GHP  
16 industry and interested stakeholders.

17 I'd first like to thank the Commission for  
18 giving me the opportunity to make some opening remarks  
19 on behalf of my boss, Assembly Member Das Williams. He  
20 wanted to be here to address you directly but,  
21 unfortunately, is in session or just got out of session,  
22 so he's tied up in that.

23 When the California Geothermal Heat Pump  
24 Coalition approached my boss last year with their  
25 concerns and proposed legislation, he knew immediately

1 that he wanted to help. He was familiar with the  
2 technology and was surprised to hear about the existing  
3 barriers in California.

4 As a Santa Barbara City Council Member, he was  
5 actually involved with the County of Santa Barbara's  
6 Courthouse Geothermal Project that installed a  
7 subsurface geothermal system to heat and cool their  
8 records office.

9 So, with the help of the Coalition behind us, we  
10 were able to pass AB 2339 last year, as Suzanne  
11 explained.

12 And so, the Assembly Member just wanted to  
13 express that he's very excited to see this bill being  
14 implemented and looks forward to following the work of  
15 the Commission and stakeholders to ensure that  
16 California's more fully -- or more fully realizes some  
17 of the benefits of this under-utilized technology.

18 So, thank you all for being here and for your  
19 work to help in this area. Thank you.

20 MR. LOYER: Thank you, Sara.

21 When we first saw the requirements for 2339, we  
22 were -- we were, I think, a little bit taken aback by  
23 our initial involvement and then we realized that this  
24 was a grand opportunity for us to really connect with  
25 the industry. And so we appreciate, actually, being

1 named in 2339, we think it's very appropriate that the  
2 Energy Commission is the lead agency in this. So, thank  
3 you very much.

4 Next, we have Hazel Miranda. She is our -- we  
5 like to call them our First Advisor to Commissioners.

6 And, Hazel, I'll let you take it from there.

7 MS. MIRANDA: Okay, thank you. Good morning,  
8 everyone. My name is Hazel Miranda. I'm an Advisory to  
9 Commissioner McAllister and just wanted to thank  
10 everyone for being present today.

11 The Commissioner would like to thank CEC staff  
12 for all of their hard work in organizing this workshop,  
13 would also like to thank Assembly Member Williams, and  
14 his staff, for his interest and leadership on this  
15 issue, and for all stakeholders that are present today.  
16 Thank you for your time.

17 Geothermal heat pump systems, along with other  
18 technologies, will help us achieve our zero net energy  
19 and AB 32 goals.

20 I look forward to engaging -- hearing from all  
21 of you and engaging in constructive dialogue in helping  
22 us come to some policy recommendations that will  
23 ultimately be published in the 2013 Integrated Energy  
24 Policy Report.

25 Thank you. Thank you for being present.

1 MR. LOYER: Thank you.

2 Next, I would like to introduce Phil Henry, who  
3 I think everybody probably knows Phil. He's been the  
4 driving force between 2339. And Phil is currently, at  
5 least, President of CaliforniaGeo, probably to remain  
6 so. Phil.

7 MR. HENRY: Good morning everyone. Thanks so  
8 much for taking time out of your day to take part today.  
9 I'll move closer to the mic so you can all hear me here.

10 So, I'll make my remarks -- I'll keep my remarks  
11 brief, but I really -- I do want to just acknowledge  
12 some people and then we have a very full, jamb-packed  
13 day planned. We've worked hard, between Lisa Meline,  
14 myself, Joe Loyer, and Craig Hoellwarth have worked very  
15 hard in a -- in a planning group to put this together  
16 for you.

17 So, for starters, I'd like to acknowledge the  
18 leadership displayed by Assembly Member Williams. As  
19 Sara mentioned, he was quick to take on this task.

20 And publicly I want to acknowledge Sara Arce,  
21 who's -- without her -- without her efforts we would not  
22 be having this conversation today. So, Sara, the  
23 industry thanks you. We very appreciate all you did for  
24 us last year and continue to do for the industry.

25 And I'd like to acknowledge the Commission. Joe

1 spoke to this, briefly, this particular piece of  
2 legislation was -- it was a little hard-hitting,  
3 unprecedented, and took on some issues front and center,  
4 and the Commission has stepped up to the plate and very  
5 aggressively taken on this task, or set of tasks. And  
6 industry appreciates that effort.

7           The relationship that is coming out of this  
8 between -- between the geothermal heat pump industry and  
9 the Commission is unprecedented. It is a collaborative  
10 effort and the industry looks forward to having that  
11 continue.

12           And I want to thank Joe Loyer for his Herculean  
13 efforts putting all of this together. Thank you very  
14 much.

15           So, with that I'll close. I look forward to  
16 speaking with all of you.

17           MR. LOYER: Well, with that what we're -- what  
18 I'm going to do, now, is just kind of go over the agenda  
19 for the day.

20           What we have are basically three sessions, and  
21 then we're going to have a round table at the end of the  
22 day.

23           And Session One is titled here, "What are GHPs  
24 and how do they work?"

25           And you know, for most everybody in the room

1 this is probably, maybe a little bit of old news. But  
2 for many of us here in the Energy Commission, it's not.

3 We have a lot of information about how GHPs  
4 work, but we would always -- we always feel like we're  
5 behind the eight ball in looking at what industry is  
6 doing. So, it's always a good idea for us to have a  
7 basic synopsis of where the industry is and what they  
8 are doing with the technology.

9 And, in particular this one, I think it's been  
10 around a long time and there have been many changes,  
11 really.

12 Session Two is going to be in the afternoon.  
13 So, we're going to have a lunch break and then we're  
14 going to go to Session Two; "What are the Potential  
15 Benefits for California." And we have many  
16 presentations there and we will have an opportunity to  
17 talk to a panel at that point, as well.

18 Session One will also have a panel.

19 Session Three will be later in the afternoon,  
20 about three o'clock. "What needs to be done for  
21 California to realize the benefits of GHPs?" And we'll  
22 be hearing from Energy Commission staff in Session  
23 Three.

24 And then we will have the Round Table, where we  
25 will have opportunities to talk to all the presenters

1 and we will have opportunities to talk to presenters as  
2 the sessions progress.

3 If you do want to ask questions, we do ask you  
4 to step up to a microphone and identify yourself, so  
5 that everybody on WebEx can hear you, and that our court  
6 reporter can get your name correctly.

7 And if you are going to speak, it's not  
8 mandatory or anything, but it would be really nice for  
9 the court reporter to have your business card.

10 So, if you can, drop it off for her, and thank  
11 you.

12 With that, I think we are ready to go with our  
13 first presentation.

14 Lisa Meline, she's with Meline Energy  
15 Engineering Corporation and is currently the  
16 CaliforniaGeo Chair.

17 And, Lisa, you can use this microphone or you  
18 can use that one. And just so our other presenters  
19 know, you can also use the microphone and we have a  
20 remote clicker, if you like.

21 Ready?

22 MS. MELINE: Ready.

23 MR. LOYER: All right.

24 MS. MELINE: Good morning. Thank you for being  
25 here. My voice isn't usually this deep and sexy. I

1 actually have a pretty good cold. So, I'll do my best  
2 and if you can't hear me, let me know. I want to make  
3 sure that I deliver all of this great information that  
4 we've put together for today's session.

5 I'm going to be addressing what I like to call  
6 "Geothermal Heat Pumps 101."

7 I want to talk about, first of all, what makes  
8 it a geothermal heat pump system. These four items that  
9 you'll see on the slide here, the extended-range water-  
10 source heat pump, ground heat exchanger, circulation  
11 pump and distribution, those are the key elements that I  
12 think of when I think about a building system, a  
13 building's mechanical system.

14 The extended-range water-source heat pump is one  
15 of the things that makes it a geothermal heat pump  
16 system, it's what's different from other types of  
17 systems.

18 And then, of course, there's the ground heat  
19 exchanger, the second bullet here, that's the kind of  
20 one kind of unknown factor that people are unsure of.  
21 They're not sure how to design it, how to manage it.  
22 And so that's what's different.

23 But the other two items on the list, those are  
24 pretty standard with building systems, building  
25 mechanical systems. Your piping systems, your duct

1 work, you know, in-floor tubing, you know, nothing has  
2 changed there.

3 Here's an example of what a geothermal heat pump  
4 system looks like. These are various configurations  
5 both water-to-water, water-to-air, they come in  
6 different boxes.

7 And, essentially, what I want to point out here  
8 is this how, in a lot of ways, it's the same. It's the  
9 similar footprint to a lot of the equipment that we're  
10 used to seeing in buildings. And so, from that  
11 perspective it's very similar.

12 Some things to point out about geothermal heat  
13 pump systems is that they are all-electric. A lot of  
14 people have the misconception that you're just simply  
15 transferring water from pipe in the earth into a  
16 building and, magically, you're heating and cooling.  
17 You do have to pay for electricity, but the dream about  
18 this type of technology is that you can produce that  
19 heating and cooling at a much lower cost, much -- you  
20 can do this much more efficiently.

21 They do not require hot water geothermal.  
22 That's kind of a misnomer with the name. We call it  
23 geothermal heat pump. But we're talking about low  
24 temperature energy, not hot water like you're used to  
25 associating with electrical power production.

1           The systems can be open loop or closed loop.  
2 Here, in California, we primarily are looking at closed  
3 loop systems. There are opportunities to do open loop  
4 systems, which would be like a water well, injection  
5 well system, but those are much more challenging to  
6 permit. And since California, in a lot of locations, is  
7 desert, you know, it kind of doesn't make sense.

8           So, the focus of my presentation will be closed  
9 loop systems.

10           And then, finally, it can be hybridized and I'll  
11 talk about that a little bit later in the slide show.

12           So, basically, how does a heat pump work? As I  
13 mentioned, we take low pressure vapor, refrigerant, we  
14 add energy to that via a compressor. That's where  
15 you're paying for the power for your system.

16           That refrigerant is then pumped through a  
17 condenser where heat is given off and then that  
18 refrigerant comes out the other side as saturated  
19 liquid. It goes through an expansion valve.

20           And then on the other end of your system, at the  
21 bottom of your slide there, the evaporator, it absorbs  
22 the heat. In this case, in air conditioning mode, we're  
23 going to be drawing that heat out of the air or the  
24 water that is part of the system.

25           So, this would be like your regular air

1 conditioning system, it's the vapor compression cycle.  
2 But with heat pumps, you have the opportunity to, with  
3 your expansion valve you put in a reversing valve here,  
4 and you can do both heating and cooling with the same  
5 box.

6           Here's another graphic for some folks who may  
7 not be familiar with the technology. If we start out  
8 looking at the item number one, this is essentially the  
9 geothermal heat pump. This is where we're exchanging  
10 the heat.

11           The example here is cooling mode and so we're  
12 going to be, basically, taking the heat out of the air,  
13 but we're really air conditioning. I mean, that's just  
14 the way the mechanical engineer in me wants to think  
15 about it.

16           But we have the box. We have the equipment  
17 inside the building. We have the ground loop that I  
18 have as diagram item number 3, outside the building in  
19 most cases.

20           And then we have number 2 here, the pump, which  
21 is circulating the fluid between the ground loop, the  
22 ground heat exchanger and the equipment in the building.  
23 And those are really the key elements.

24           The distribution system and all of that, as I  
25 said, is no different than what you're used to seeing.

1           You'll see to the left a water heater. One of  
2 the things that you can do, in certain locations it  
3 makes sense to add a super-heater feature, where what  
4 you're doing is essentially a heat recovery. You're  
5 pulling the heat out of the refrigerant before it dumps  
6 the heat into the fluid, to pre-heat water or other  
7 processes within a building.

8           One of the things that is different about  
9 geothermal heat pump systems is the way we talk about  
10 their efficiency. I'm not going to delve into this too  
11 deeply because Dr. Kavanaugh is going to be addressing  
12 this.

13           But, typically, when we're talking about  
14 geothermal heat pumps, we're talking about coefficients  
15 of performance when we talk about its heating efficiency  
16 and energy efficiency rating for cooling efficiency.  
17 And we never talk about SEER with this equipment.

18           The second item, as I mentioned, that makes  
19 these systems somewhat different from the mechanical  
20 systems we're used to dealing with is the ground heat  
21 exchanger.

22           So, what I'd like to do is talk to you a little  
23 bit about this. It is, you know, the renewable  
24 connection. The ground loop is in the earth. And the  
25 reason we do that is because we like to tap into that

1 constant temperature that we see when we get below, say,  
2 15 feet below the surface.

3           It's maintained a constant temperature for the  
4 most part year-round, the sun's shining, heat is being  
5 added. You know, we've got cool days and hot days.

6           We do get a little bit of heat from the core,  
7 which is what a lot of people think about with  
8 geothermal, but it's really negligible when you think  
9 about everything going on outside.

10           So, what we want to do is we want to take  
11 advantage of that constant earth temperature below our  
12 building, outside our buildings.

13           If you think about Sacramento, in particular, a  
14 design day is maybe 30 degrees in the wintertime. The  
15 deep earth here is about 65 degrees. And so if you're  
16 thinking about trying to draw heat, extract heat and  
17 bring it from the air or from the ground into the  
18 building, there's a pretty good advantage there.  
19 There's about a 35-degree advantage.

20           Likewise, in the summertime, when we're trying  
21 to reject that heat from our buildings the earth, again,  
22 is a 65 degrees, which is a much more favorable heat  
23 transfer than to the outside air, which is about 105  
24 degrees during a peak summer day here in Sacramento.

25           So, we're taking advantage of transferring that

1 energy in the most positive direction and taking  
2 advantage of that earth to do that.

3 So, you know, here's just another picture of how  
4 that diagram I showed you earlier may be viewed.

5 So, how do we do that? There's all different  
6 kinds of ground heat exchangers. The one that we see  
7 most frequently here, in our State, is the vertical loop  
8 system.

9 Basically, these are some different examples of  
10 how you might construct that. Basically, what we're  
11 going to do is we're going to drill a hole in the earth,  
12 we're going to make a borehole at whatever depth the  
13 design engineer has specified. Typically, we would see  
14 that between, you know, 200 and 400 feet here. All  
15 kinds of different drilling conditions going on so,  
16 obviously, that's part of the equation.

17 But in that borehole we would then insert high-  
18 density polyethylene pipe. That pipe will be pushed  
19 down to the bottom of that borehole. And then we would  
20 fill that borehole with grout because what we want to do  
21 is make sure -- we do that for two reasons. One is to  
22 make sure we have a good connection between that pipe  
23 and the borehole wall.

24 And the other is that we want to protect our  
25 groundwater. We want to make sure that we don't create

1 a pathway for either groundwater or cross-contamination  
2 between aquifers to a core. So, that is basically how  
3 that works.

4 We typically work with fused pipe. This is  
5 plastic pipe. They also use it in the gas industry. We  
6 want to fuse this pipe because we want it to last a long  
7 time. You know, we're investing in this ground heat  
8 exchanger, we want it to last the 50 years or so that a  
9 lot of the manufacturers will warrant it for.

10 And we don't want to have mechanical fittings.  
11 We don't want to have opportunities for failure and  
12 corrosion. So, this is the way that we recommend these  
13 systems, we actually specify them to go in.

14 And then, of course, once you're drilling all  
15 these boreholes you have to have a way of connecting  
16 them all together. So, we need to connect them together  
17 with this fused pipe like you saw in the photo prior to  
18 this.

19 We want to bring them through a trench and a  
20 headering system into our building. So, here's some  
21 pictures just showing you what that might look like out  
22 in the field. This is an example for a project down in  
23 Alamo.

24 Again, the plastic pipe is what we want to use  
25 on all of these systems. This is an example of how you

1 might receive the pipe from the manufacturer. It's  
2 already come to the site on pallets at the correct depth  
3 or length that we need.

4           The U band or the fitting at the bottom of the  
5 pipe that brings them together so that you can transfer  
6 that water all the way down to that borehole, and then  
7 back up again, it's all ready to go and ready to be  
8 inserted into those boreholes.

9           And then, of course, we're going to be doing  
10 backfilling of that entire system the way you would  
11 normally do with any type of other, you know, buried  
12 piping system.

13           One of the things that's very important with  
14 these systems, and where I've seen a lot of problems  
15 here in our State, is that the systems are not properly  
16 flushed. It's really important that once you get this  
17 ground loop, this ground heat exchanger where it needs  
18 to be that the system be properly flushed of all the  
19 debris that is just part of being -- part of going  
20 through the construction process. It needs to be at a  
21 specified 2-foot-per-second velocity as a minimum and  
22 for a certain amount of time to get all of the air out  
23 of the system.

24           So, having said that, that's the basic  
25 construction of an example for a vertical loop system.

1           How do we design this? This is the part that  
2 baffles a lot of engineers and owners, you know, how do  
3 we do this? How do you design it? How do you know how  
4 much pipe to put in the ground?

5           Well, we need to know the properties of the  
6 earth, first, of where this ground heat exchanger is  
7 going to go. So, we need to understand what the deep  
8 earth temperature is, that's very important, the  
9 conductivity of the soil, which is the ability of the  
10 earth to move heat in and out of the surroundings and  
11 into that pipe, and then the thermal diffusivity of that  
12 particular formation or earth where we want to put this  
13 ground loop.

14           And how do we get that information? Well,  
15 that's a little bit of a challenge in California. We're  
16 a little different from a lot of other states.

17           But if you do have access to a well log, it is  
18 not public -- it is not available to the public,  
19 typically, but if you know some drillers that have some  
20 well logs in the vicinity of where a project is going to  
21 be, you can look at the type of soils and rocks that you  
22 might encounter in a certain location and kind of  
23 estimate connectivity from that.

24           There's experience. If you do a lot of work in  
25 this industry, you start to kind of become familiar with

1 you might encounter in certain locations.

2           And if you just don't know, you can always do a  
3 thermal conductivity test. And that's something that we  
4 typically recommend for larger projects because it is --  
5 it can be quite costly.

6           And so, the advantage is that if you have a  
7 better understanding of what your earth properties are,  
8 you can do a better design and try to keep the cost of  
9 that ground loop system down, which is typically what a  
10 lot of people will say is one of the biggest challenges  
11 with this technology.

12           So, basically, a thermal conductivity is, in a  
13 nutshell, you're just putting in that first borehole.  
14 You're putting in that first U band. You're going to  
15 circulate water through that individual loop. You're  
16 going to measure what that deep earth temperature is in  
17 the first moments of that test.

18           And then you're going to apply heat. And what  
19 happens is when you apply that heat over time, after  
20 about eight or ten hours into that test you will be able  
21 to measure the differential temperature being seen in  
22 that system. And when you plot that on the log graph  
23 you get a slope of a line and that magically becomes  
24 your conductivity.

25           And there's been a lot of research papers on how

1 to do this test, there are different methods, but the  
2 line source method is the one that is more commonly used  
3 in the industry, currently.

4           Here's an example of a well log. If you're not  
5 going to do the thermal conductivity test, you can find  
6 information such as this and do an estimate, a weighted  
7 average of that conductivity.

8           And what else do we need to know? This is the  
9 part where the engineers have to determine what that  
10 ground loop size, depth, spacing, what water  
11 temperatures they're going to define for the heat pump  
12 to determine what levels of efficiency they're going to  
13 realize from that system.

14           And then, also, there's a pumping piece that you  
15 need to know.

16           So, this is the design part. These are the  
17 things that have to be traded off in design to try to  
18 create the best, most efficient design for the  
19 particular site, any constraints it might have, and also  
20 the budget being provided.

21           Another way of doing this type of system, it's  
22 not really a ground loop, we call it a surface water  
23 loop, but it's another way of doing heat exchange with a  
24 body of water.

25           Here's an example of a project over off the

1 coast. Basically, the same plastic pipe is put into  
2 coils, put on a frame, and it is taken out into the  
3 middle of this pond. And, basically, obviously, you're  
4 going to want to keep air in the pipe so you can get it  
5 out there, and then you fill it up with water and you  
6 sink it.

7           And what we're able to do, then, is use that  
8 body of water as a heat transfer medium rather than the  
9 earth, itself.

10           And this is just to show you that if you happen  
11 to be in this business, it's perfectly okay to have a  
12 kayak in your shop as part of your -- one of the tools  
13 you need of the trade.

14           So, again, here's how that pipe might look as  
15 you would want to attach it to that frame and put it  
16 into that pond, or lake, or river, or whatever you're  
17 looking to do here.

18           You can also use a plate frame or a plate heat  
19 exchanger. A lot of times you'll see these on  
20 properties that have piers, or things leading out to  
21 their lake or pond, and so it's a lot easier to just  
22 attach this.

23           There's horizontal loops. A lot of times this  
24 is referred to as a trench system because you're  
25 basically digging trench, typically about five feet

1 deep. We don't want to go much deeper than that because  
2 there are issues of shoring, you know, and safety of  
3 people working in these trenches.

4 And, obviously, this deviates from project to  
5 project, but you can put one pipe, two pipes, four  
6 pipes, Slinky pipes. There's a lot of different ways of  
7 doing this and there are obviously tradeoffs within the  
8 design process.

9 But these are just examples -- you know, this is  
10 to give you an example of ways you might do this heat  
11 exchanger.

12 Here's an example of a horizontal Slinky system.  
13 This is a project up in Grass Valley. This particular  
14 project, the ground heat exchanger was put in, the soil  
15 was removed, the ground exchanger was put in, the soil  
16 was put back and then a slab on grade was poured for  
17 like a big box retail store.

18 So, there's all different ways that you can do  
19 the ground heat exchanger portion of the system.

20 Horizontal or directional drilling, this was  
21 mostly started by the fiber optics industry putting in  
22 cable, and things like that. It is also equally  
23 applicable to getting pipe in the ground, if you will.

24 The idea is that you are drilling a borehole  
25 down under the surface of the finished grade, 15, 35,

1 different depths, whatever your drilling equipment has  
2 capability to do.

3           In some occasions you will drill down under and  
4 then come up on another side, say on the other side of  
5 the property or on the other side of a building, and  
6 this allows you to pull that U band pipe back through.

7           Or, in other cases, depending on the conditions,  
8 you might just drill down and leave that pipe buried at  
9 10 or 15 feet. It just, again, depends on your  
10 particular site and the capability of the drilling  
11 equipment and the driller.

12           One of the things that's really important to  
13 understand about this technology is that it really works  
14 best, and it really should only be designed for systems  
15 that both have heating and cooling demands over the  
16 course of a year.

17           The idea is that the ground is like a -- it's  
18 like a heat storage device, right. So, in the  
19 summertime when you're pulling heat out of your building  
20 and you're rejecting it to the earth, you need to turn  
21 around and pull that same energy out of the earth and  
22 use it in your building later in the year.

23           The most ideal situation is to have a balance  
24 between heating and cooling, but we realize that that  
25 isn't always possible. And so, you have to make sure

1 that you accommodate for that in your ground heat  
2 exchanger designs.

3           And if you have a situation where you have a  
4 severe imbalance, you can also look at hybrid systems.  
5 Hybrid systems are good for a couple of reasons. One is  
6 that it is a natural partner for other renewable  
7 technologies like solar thermal, PV.

8           In this example that I show here, this is a  
9 solar hot water heating system where, obviously, solar  
10 is the primary heat source and then we use the  
11 geothermal heat pump as a backup to that.

12           One of the ways that we're looking at getting to  
13 net zero is instead of having the solar thermal panels  
14 you might have PV panels that would be producing your  
15 electricity that would then operate your very efficient  
16 geothermal heat pump. So, there's different ways of  
17 looking at that.

18           One of the things that we see mostly on large  
19 commercial projects is a hybrid system where you design  
20 the ground loop to take care of your heating  
21 requirement. It's going to be your heat extraction;  
22 it's sized for heat extraction.

23           Because, typically, with large commercial  
24 projects they tend to be cooling dominated, which means  
25 you're putting more heat into the ground than you can

1 take out. Even in colder climates you will often see  
2 this.

3           So, often, you know, if a lifecycle cost is  
4 done, it's more cost-effective in some cases to use a  
5 cooling tower or fluid cooler as an additional heat  
6 rejection device in your hybrid geothermal heat pump  
7 system.

8           So, here's an example of that. I know it's kind  
9 of a busy slide, but what I wanted to show is that there  
10 are different ways of applying this technology. It's  
11 quite -- can be quite innovative.

12           Now, one of the things that I was asked to speak  
13 about, which is actually a really good way to segue into  
14 some other discussion we're going to have in this  
15 session, is when we look at lifecycle costs we're trying  
16 to determine the cost of a system over its useful  
17 lifetime. We're looking at first costs, we're looking  
18 at operational costs, we're looking at maintenance  
19 costs.

20           This page here is from the ASHRAE 2011 HVAC  
21 Applications Handbook. And I know it's kind of hard to  
22 see. I think if you're looking at this on your computer  
23 screen, in your office right now, people that aren't in  
24 this room, you'll see that for commercial water-to-air  
25 heat pumps the 2005 data that's published by ASHRE shows

1 that the lifetime of that equipment is 24 years or  
2 better.

3 For chillers, if you were to, say, compare a  
4 geothermal heat pump system to a bore pipe central plant  
5 system, you would have a chiller. If you compared the  
6 lifetime of the chiller to that heat pump, it's saying  
7 25 years, so they're very close according to this data  
8 in lifetime.

9 But what I also want to point out to you in this  
10 information is that's 2005 data. And if you look at  
11 everything else in that chart, there really is very  
12 little information out there.

13 If you go back to the previous data that was  
14 quite extensive research that was done back in 1978,  
15 they show some different and older data. It's dated,  
16 but that's 30-year-old data.

17 So, what I'm really trying to show here is that  
18 even within ASHRE, which is the society that's taking  
19 the lead on a lot of this research and providing useful  
20 tools to engineers, we just really don't have a lot of  
21 that data.

22 I serve on one of the technical committees  
23 within ASHRE that deals with this technology and for the  
24 last ten years we, or really Dr. Kavanaugh and some of  
25 the people that have been on the committee longer than I

1 have really been pushing to try to get this information,  
2 to try to get some research dollars to collect it. And  
3 we've just not really been successful.

4 But, fortunately, Dr. Kavanaugh has approached  
5 the Tennessee Valley Authority, the Southern Company,  
6 and with funding from EPRI has recently done quite a bit  
7 of research and gathering of this information, which  
8 he'll be sharing with you later.

9 There's also been a series of seven articles  
10 published over the last, probably, ten months within the  
11 ASHRE Journal that shares this information with the  
12 engineering community and any other folks who may be  
13 interested.

14 So, what I would like to do is just give you an  
15 example. This is the most recent and final of those  
16 seven articles within the ASHRE Journal. Dr. Kavanaugh  
17 allowed me to co-author this with him. Thank you very  
18 much, Steve.

19 But within that we talk about commercial GHP --  
20 he says GSHP, I say GHP -- geothermal heat pump  
21 performance and how to achieve quality.

22 And with that, Steve, I'd like to turn it over  
23 to you.

24 Are we supposed to take questions or at the very  
25 end?

1           MR. LOYER: Given that we're so advanced in our  
2 schedule here, it's only 10:40, we can take questions  
3 now if you feel comfortable with that, Lisa, or if you  
4 want to wait until after Dr. Kavanaugh.

5           MS. MELINE: I think maybe it would be better if  
6 we got through all of the presentations because we might  
7 answer some of the questions as we move through.

8           MR. LOYER: That's a good idea. We'll hold  
9 questions until the end, then.

10          MR. KAVANAUGH: Okay, thanks for the  
11 opportunity. You can see I've come a little ways. Lisa  
12 was helping me on another project so we kind of traded  
13 off on this.

14           One of the things that was on the list of things  
15 to talk about was the difference in the rating  
16 procedures and how they fit together, possibly how you  
17 convert one to the other. So, we're going to talk about  
18 those things.

19           And because they are used quite a bit in  
20 performing these lifecycle cost analysis, and predicting  
21 energy use, and that sort of thing, so I just wanted to  
22 show you the guts of these things.

23           So, with that, okay, so what is SEER, seasonal  
24 energy efficiency ratio, it's a procedure that was  
25 developed, actually, in the seventies and promulgated in

1 the mid-eighties by the Department of Energy.

2 The reason source of it comes from the Air  
3 Conditioning, Heating and Refrigeration Institute, and  
4 there's the standard number.

5 And there is a shortcut method to getting SEER,  
6 and that method assumes the outside temperature is 82.  
7 Not so hot. And the indoor conditions are 80 degrees,  
8 what we call dry bulb temperature, the temperature on the  
9 thermostat, and 67 wet bulb which is about 50 percent  
10 relative humidity, and that's not comfortable.

11 People do not set their thermostats at that  
12 point most of the time.

13 Going into a little bit more detail, for those  
14 of you that are engineers, and some of this I realize  
15 may be more on the engineering take, but we have a lot  
16 of, hopefully, engineers out there or people who work  
17 with heating and air conditioning systems.

18 And this revolves what's called external static  
19 pressure, which is the pressure that you have to deliver  
20 on the outlet of the heat pump to drive the air through  
21 the system.

22 And they've got three ranges of the heat pumps,  
23 and this is about a -- it's thousands of Btus per hour.  
24 This is up to about two tons, a little over two tons.  
25 this is a two, a three ton, a two and a half ton, a

1 three ton size heat pump.

2           You see these numbers over here represent the  
3 amount of pressure in inches of water. And people that  
4 design these systems would actually be pretty crazy if  
5 they used this low of pressure.

6           The other thing is that they assume that the  
7 loss across the air filter is a really small amount.  
8 Typically, the filters we use today the numbers, even  
9 when they're clean, are like three, or four, or five  
10 times as big as that.

11           So, the next result of it is you've got a real  
12 small fan here and it will actually drop the SEER around  
13 two points. So, it's a 14 and you apply what a fan  
14 really would be doing, it would drop it down to a 12,  
15 okay.

16           There is no latent requirement, which I  
17 understand that doesn't bother people in California as  
18 much as it does the people in Alabama.

19           There's a cycling degradation. And my thought  
20 on it is if it's 82 outside in California and you want  
21 it 80 inside, you might as well just open the windows.

22           Now, the other thing that disturbed me is this  
23 is the shortcut that I just showed you. And so, what I  
24 have here is a listing of heat pumps from one  
25 manufacturer that shows the seasonal energy efficiency

1 ratio for a 19 SEER product line and a 14 SEER product  
2 line. So, it's the three-ton units, the four-ton units,  
3 and the five-ton units.

4 And in order to get a 19 SEER series all you  
5 have to do is have one heat pump in that series that  
6 makes a 19 SEER. So, what they'll usually do is put a  
7 three-ton outdoor unit with a four-ton or five-ton  
8 indoor unit to get that 18 SEER.

9 But you can see here these are the actual SEERs  
10 for these heat pumps. And what I'm doing is comparing  
11 the 19 SEER product line with the 14 SEER product line  
12 using the same size indoor coil.

13 And you can see the SEER for this 19 is 17.6,  
14 not quite 19, but its EER when the outdoor temperature  
15 is 95 is 12.1, where the 14 SEER product line has got a  
16 SEER of 15, but it actually has a much higher -- or not  
17 a -- a higher EER at 95.

18 And as you see, as you go down in increase in  
19 size here, the discrepancy between the EER at 95,  
20 between the high-efficiency and the mid-efficiency  
21 system gets worse. So, the mid-efficiency heat pumps  
22 have a much better average EER at 95 compared to the  
23 higher SEER products.

24 So, that would drive the utilities crazy, if I  
25 was a utility. You've got a product that you're

1 rebating that does better when it's mild. And don't you  
2 all have like brown-outs and black-outs here in  
3 California? Yeah.

4 So, basically, the high SEER products are  
5 hurting you worse than the mid-SEER stuff, okay.

6 Now, how does that happen? Okay, this is the  
7 long cut method. And this slide and the next two may  
8 get a little more technical, but I do need to put this  
9 information out there.

10 I see Joe, is it, is shaking his head, so he  
11 kind of -- I think he understands what we're talking  
12 about. So, I'll try to explain it.

13 What you have is what's called a Bin  
14 calculation, Bin energy Calculation, and Bin being  
15 temperature points.

16 And what we have is the SEER requires a thousand  
17 hours, okay. And, again, the SEER calculation uses that  
18 80 degree indoor temperature.

19 But of those 1,000 hours, 660 or 66 percent of  
20 those hours the outdoor temperature is either 77, 72, or  
21 67. So, for 66 percent of the time the outdoor  
22 temperature is milder than the indoor temperature.

23 And here's some points up here. Phoenix, Dallas  
24 you see. If you go up to the higher temperatures, you  
25 see only less than one percent is above a hundred and

1 less than two percent is between 95 and 100. So, very,  
2 very little temperature points in these ranges when it  
3 really gets hot. So, keep that in mind when you're  
4 looking at SEER.

5 Now, the next one -- all right, now, this is  
6 the -- I have to admit, this is the most technical slide  
7 I have in here. So, if you don't completely understand  
8 my explanation in this short period of time, I can  
9 answer some questions.

10 But the real point is on the next slide. Okay,  
11 this is what is a graphical representation of what  
12 happens. On this line we have outdoor air temperature.  
13 Over here it says COP, but this will be the capacity of  
14 the heat pump in cooling.

15 So, as the temperature, this point right here is  
16 72, as that outdoor temperature increases, this is the  
17 load line that goes up, up, up, up and it gets hotter  
18 and hotter until it gets to a hundred. So, you have a  
19 high load at this point, okay.

20 This is the same thing for the other side in  
21 heating, right here about 65 you have no load, and then  
22 as the temperature gets lower and lower that load goes  
23 up, okay.

24 This is from the ASHRAE Handbook.

25 Now, what I want to point out is if you set your

1 thermostat at, say, 75 in cooling, and 70 in heating,  
2 there will be a five-degree outdoor temperature range  
3 where you have no heating or cooling requirement. It's  
4 called the dead band.

5 All right, now, we're going to flip over to  
6 here, to where the air conditioning industry who  
7 developed, essentially, this and their assumption is --  
8 okay, we saw on the last slide that there is a load at  
9 67, because they did the Bin temperature. Remember,  
10 they had the 67 on there and they're including that very  
11 efficient operating point.

12 So, that would mean we go down five degrees, so  
13 the no-load point is 62. So, there's no load at 62.

14 Now, if we were to follow this procedure over  
15 here, that means we would go back ten degrees and start  
16 at 52 because they're asking us to set our thermostats  
17 at 80 in cooling and 70 in heating, so there would be a  
18 ten-degree difference, and that line would come up right  
19 across here.

20 Rather than the assumption is that we have the  
21 no-load at 67, okay.

22 Now, I'm going to flip, just a minute, so we  
23 should have a ten-degree band in here where we need no  
24 heating or cooling. But the calculation, we're flipping  
25 over to heating seasonal performance factor. That's the

1 same thing as the SEER, but it's for heating. It's Btus  
2 per hour of cooling divided by the watts input.

3 But you'll look over here and you'll see that  
4 those three points, 62, 57, and 52, which shouldn't even  
5 be heating or cooling, contain about 35 percent of the  
6 hours for which we calculate the heating efficiency,  
7 okay, and that's when they're most efficient.

8 So, I'm just saying -- and then for a commercial  
9 building you probably wouldn't even need any heating at  
10 these temperatures.

11 So, again, remember that both SEER and HSPF  
12 assume very, very, very optimistic conditions when  
13 they're calculated in their values.

14 The other thing is, these next two slides show  
15 you, and it's becoming increasingly difficult to get  
16 information in order for people to conduct simulations,  
17 lifecycle cost analysis. This is all you have to  
18 report, okay.

19 I've kind of blown this up. This is off the  
20 AAHRI website, so you'd have to tell it what the  
21 capacity is, the EER, and the SEER.

22 Now, they also list the heating seasonal  
23 performance factor, the capacity with the outdoor  
24 temperature at 47, and 17, but they don't tell you what  
25 the efficiency is. They don't have to report the

1 efficiency.

2           So, how are you going to figure out, if you  
3 don't have the efficiency and the energy use, how much  
4 energy the systems are consuming?

5           Now, we have this environmentally acceptable  
6 refrigerant, R-410A, which everyone's using these days.  
7 This is the refrigerant that we have no longer allowed  
8 to be -- equipment to be produced for, R-22, R-410-A.

9           The secret that I think they keep pretty silent  
10 is R-410A is not a very efficient refrigerant when  
11 things get hot.

12           As a result, the manufacturers used to report in  
13 their -- this is from -- I guess it's from Carrier, the  
14 total capacity, the sensible heat capacity, which tells  
15 you something along the lines of how well it de-  
16 humidifies, and the kilowatts into the unit.

17           Okay, you see those three points? Okay, so  
18 nowadays, when you try to go get information about 410A  
19 what's missing? It's difficult to get this information  
20 from manufacturers. They don't have to tell you. And  
21 when they do tell you, if it's not at a rating point,  
22 you don't really have a guarantee that they're telling  
23 you all of the details.

24           So, again, look at that. Total capacity,  
25 sensible capacity, but no KW.

1           So, I'm wondering how these people are doing  
2 these models and these lifecycle cost analyses when we  
3 can't even get the data.

4           Okay, now, switching to ground source heat  
5 pumps. And, of course, you'd expect me to say great and  
6 wonderful things about this, which I do, but to some  
7 extent we've got good news. Is that rather than  
8 assuming a load in this stuff, we get this at different  
9 temperature points, 86, 77, and 59 for cooling. And for  
10 heating it's 68, 50, and 32.

11           But the bad news is they also kind of cheat on  
12 the conditions, just like the air source people. Okay,  
13 indoor temperature 80.6, the dry bub 66.2, the wet bub,  
14 those are nice metric round numbers and they go even  
15 worse than the air manufacturers -- the efficiencies  
16 that are reported, with no external fan pressure and no  
17 pump power.

18           At part-load, they do it at 68 degrees. You get  
19 your part-load cooling efficiency at 68. So, if inside  
20 the house is 80.6, the ground loop's 68, so you're kind  
21 of pumping heat down here, which is sort of like rating  
22 the miles-per-gallon of a truck going downhill. So,  
23 we've got to kind of watch that.

24           The other thing is that the manufacturers, this  
25 bothers me a lot, that they advertise their variable-

1 speed, multiple-speed heat pumps have an EER of 50,  
2 okay.

3           So, here's how that's done. This is a product  
4 line where this particular heat pump at part-load, this  
5 is a four-ton unit, you can see it's got an EER of 53.2.  
6 Isn't that wonderful.

7           Okay, but let's look at that. That's with a  
8 water temperature of 59, okay, and air flow blowing over  
9 the coil at 1,500 CFM. This is, at part-load, about a  
10 ton-and-a-half unit, okay, and you're blowing 1,500 CFM.  
11 So, that's about 900 CFM per ton. It won't work. No  
12 de-humidification and you'll be blowing about 70-, 80-  
13 degree air on people in the heating, okay, so be  
14 advised.

15           Now, if we switch this to a rating system where  
16 you're actually going to be looking at 86 degrees, which  
17 is most ground loops and cooling, and most ground loops  
18 and heating are going to run 50, or 45, in that range,  
19 okay. Here's the single speeds, 3-, 4-, 5-ton, dual  
20 capacity, and the variable capacity.

21           And when I do the same thing I did to those air  
22 source units you can see the single-capacity units,  
23 which costs typically about a third of the cost of this  
24 unit right here, it's got a higher EER average than this  
25 50-EER system, okay.

1           In heating, the same thing, 4.9, when the  
2 water's 50 degrees and at your full load versus 4.4 for  
3 the really high efficiency. This is kind of an in  
4 between model. It's a dual capacity.

5           One other thing that I really wanted to stress  
6 is the real commercial applications in the ground source  
7 heat pump system. Really, the difference between what  
8 you can get with a commercial ground source heat pump  
9 and a traditional the improvement is, in my mind, much  
10 more significant than in the residential sector.

11           This is what you see with a lot of larger  
12 buildings, mid-sized buildings, chilled water, variable  
13 air volume system. And look at all the components.  
14 You've got the compressor, which is very efficient.  
15 You've got supply air handlers in the supply system.  
16 You've got fans in the return. You've got fans in a lot  
17 of these terminals in the different rooms. You've got a  
18 pump over here, and you've got a pump over here, and  
19 you've got a fan up here, lots and lots of equipment.

20           Ground source you've got a compressor, a fan  
21 here, and a pump here.

22           So, when we go to adding up and converting what  
23 they call KW per ton to EER, look at all this system.  
24 You've got all these different things. These are the  
25 fans which add heat to the system and take away cooling

1 capacity in that mode. So, you're looking at 225 KW to  
2 get 142 net tons.

3 This is what the chiller puts out, but because  
4 of this heat this is all you get that's left. So, your  
5 EER ends up being 7.6.

6 Whereas in a properly designed ground source  
7 system here's the fan heat, much, much smaller fans.  
8 You still have a pump but it's not heating up. Just  
9 like these pumps, it doesn't heat in the building. And  
10 you can see when you add these up it's 146 KW for --  
11 where did I put the net ton? Oh, there's the net  
12 tonnage. We both started out with 168 tons, but because  
13 we have smaller fans, smaller pumps we come up with 163  
14 net tons. So, our EER is 13.4.

15 Now, a summary of this section, I really believe  
16 that SEER, HSPF and part-load ground source heat pump  
17 efficiencies, and KW per ton, they're for marketing  
18 purposes.

19 And any good engineer wouldn't use them for  
20 calculations.

21 You have a difficult time getting information,  
22 but for air source heat pumps the only thing we can  
23 really hang our hat on is the EER at 95 outside air  
24 temperature and then the heating capacity and COP at 17,  
25 and 47, of course. That's what you really ought to be

1 looking at.

2 Ground source heat pumps I like to see 86-degree  
3 evaluation, and the 50 or 32 in heating.

4 And then, finally, the demand of the auxiliary  
5 components for non-unitary systems is -- it makes it  
6 very difficult to determine the efficiency of larger  
7 systems.

8 Now, what do I do now, Lisa, to get to the  
9 next -- am I over time already?

10 MR. LOYER: No.

11 MR. KAVANAUGH: Okay. Okay, this is the result  
12 of the field study that we did to try to identify  
13 characteristics of systems that work very well and,  
14 also, to try to get the improved future installations  
15 and get the costs down.

16 The sponsors were EPRI, the Southern Company  
17 Tennessee Valley Authority. We've actually been  
18 extended to start doing this in other parts of the  
19 country. That's kind of why I'm here, Lisa's helping me  
20 find some sites around here so that we can extend this.

21 You can see this -- if there's not an ASHRAE  
22 member, there's my website right there where you can go  
23 and read these if you're bored to death and you want  
24 some more details.

25 We chose to use Energy Star as our indicator of

1 energy efficiency because it's not perfect, but it's  
2 inexpensive, and it's quick, and it creates a comparison  
3 from school to school, office to office, and it corrects  
4 for the primary things that make a difference in a  
5 building, like how many people, how many computers, how  
6 long it's operated.

7           And what this means is that this particular  
8 building got an Energy Star rating of 84, which means  
9 it's better than 84 percent of the buildings like it  
10 when you correct for everything.

11           A 75 will get you a little plaque.

12           Okay. We also at this time, this is very  
13 similar to the rating system that I was subjected to as  
14 a professor when they say, oh, you're a good teacher and  
15 people would say, no, I don't agree with that. I  
16 strongly disagree with that.

17           So, we came in and modeled that after "are you  
18 happy with your summer temperature, your winter  
19 temperature, the noise levels, the air quality, the  
20 lighting, the maintenance, and can you set your own  
21 thermostat."

22           But, of course, this is the one we got the most  
23 comments, both negative -- mostly negative. Engineers  
24 not allowing -- I can't imagine trying to teach eighth  
25 graders and not have control over my thermostat. But

1 that's some of the things we asked in this thing.

2 I don't have a -- in the limited amount of time,  
3 we don't really have time to go into a lot of detail.

4 But this is the results of about 40 buildings  
5 and you can see an average building, with an Energy  
6 Start rating of 50 is right here.

7 And that most of them did very well. But just  
8 because it's a geothermal heat pump doesn't mean it's a  
9 good one. We had a one here, okay.

10 This one was at a utility office, these were  
11 schools that thought they were doing a really good job  
12 until we rated them.

13 But I do want to call your attention to this  
14 right here. Three of the engineering firms did almost  
15 all of these buildings and it's a very, very important  
16 point that there are good engineers out there, but there  
17 are some that aren't doing their jobs.

18 We broke this into four different kinds of  
19 systems. This is the most common, a large, central  
20 ground loop, multiple heat pumps inside the building.  
21 You bring it into a building and you pump the water all  
22 through the building.

23 So, the heat pumps, like Lisa showed, are the  
24 most common way of doing this. But I see an increasing  
25 number of folks just taking and hanging a ground loop

1 onto a conventional chilled water system.

2 Do you remember the one with all the fans, with  
3 all the high KWs? I'm seeing this quite a bit in  
4 California, lately, okay.

5 So, let's look at what those did when we put  
6 them -- separated them out. So, these are ones with  
7 constant speed pumps. These are ones with variable  
8 speed drives on the pumps, which change the flow rate of  
9 the pump.

10 So, you can see we had some in the 90s, but it's  
11 just sort of an average. Remember, this is average.  
12 This is only slightly above average.

13 We did two chilled water systems with VAVs.  
14 Look at them. Now, this is an expensive system. Not  
15 only do you have the cost of that ground loop, but  
16 you've got all that cost of that chilled water system.  
17 Remember all those gizmos I had in there? So, it's a  
18 very costly system and, look, it only got 20s, so keep  
19 that in mind.

20 Now, this is the one-pipe system. These were  
21 actually retrofits, most of them that we monitored in  
22 central Illinois. They were, by and large, the lowest-  
23 cost systems that we surveyed. They're very simple.  
24 You just pump out to the ground loop, water comes back  
25 to the building, the little pump comes on and you suck

1 the water out through the heat pump, and then pump it  
2 back into the same pipe and it goes around the building,  
3 okay.

4 Most people say, oh, well, that won't work.  
5 You're putting the hot water back into the same water  
6 that used to be cool or vice-versa and -- but the cost  
7 is low, so what about the performance?

8 We looked at five buildings -- or six buildings  
9 and they were all above 90. The average is about 95.  
10 The only one that fell below a 90 was this building that  
11 was built in 1938. So, a relatively inexpensive system,  
12 high Energy Star ratings.

13 I sort of created something that I was really  
14 hoping to get going, but it's only among a few  
15 engineers. This is an engineer in Texas, and he's got  
16 slightly better average scores than the proponent of the  
17 one-type, and they're always going back and forth at  
18 each other, okay.

19 So, this is just a really simple system.  
20 They've been doing these in Texas. There's over a  
21 hundred schools in Texas, probably close to 200 schools  
22 in Texas where they just simply put a heat pump in each  
23 classroom and connect the ground loop, usually two or  
24 three boreholes, to the one heat pump and you've just  
25 got a little, bitty circulated pump on and off, okay.

1           They do these in the classroom. They don't  
2 usually do these in the common areas, the larger areas.

3           But if you'll look at the results, like I said,  
4 his average was 96. And the one-pipe guy, his average  
5 was 95. You can see he actually had a hundred. He has  
6 four schools in Texas, in this one school district,  
7 which is 30 something schools, four of them received a  
8 100. This one is one of the older ones. So, you can  
9 see really good results from that technology.

10           Another technology is a kind of combination of a  
11 central loop and individual loops, where you have a heat  
12 pump on this -- six heat pumps shown on here, and they  
13 have these little, bitty circulator pumps and a check  
14 valve. So, they're pumping back to a common loop here.  
15 And those had a mixed result, but there's some that did  
16 very well, one with a 97.

17           And then these didn't do as well, but that's  
18 because the schools that they were serving in weren't  
19 completely ground source, and then we had one kind of  
20 screwed up here.

21           I've got some numbers here and not going to --  
22 but, typically, you know, in your area most of the  
23 ground loops are probably going to be over 200 feet of  
24 bore per ton to be successful. So, we've got a lot of  
25 dots on there that we normalized how well the things did

1 with regard to the loop temperatures.

2 I had to write an extra paper when this appeared  
3 and what showed up was the buildings with thermostats  
4 actually had a higher Energy Star rating than the  
5 buildings with building automation systems, so it was  
6 kind of a -- I said, why did that happen? Don't have a  
7 lot of times --

8 The other thing we did was we looked at the cost  
9 and one of the things that we've noticed is the cost  
10 for -- this is for the ground loop cost here, these dots  
11 with nothing in the middle of them. And this is the  
12 total system cost, which is the ground loop at the  
13 system.

14 So, you can see the ground loop costs right  
15 around \$5.00 a foot, but we don't have any from  
16 California in here. They'd be much higher. There would  
17 be some dots up here, probably.

18 But you can see it's 26 percent of the total  
19 cost.

20 And I will tell you a little bit more later,  
21 there was another survey done in '95 and the increases  
22 in costs are interesting.

23 So, here's my summary slide. Most of the ground  
24 source heat pumps did very well, 61 percent of them got  
25 an Energy Star rating, 33 got above 90, one-third of

1 them.

2           The Unitarian, the one-pipe did the best, with  
3 averages around 95 or 96. Central loops 61. And we've  
4 got some ground source heat pumps that don't work very  
5 well, okay.

6           Now, here's the last point I want to make.  
7 Since this 1995 survey the cost of the ground source  
8 heat pump systems inside the building have gone up 175  
9 percent, okay.

10           Look at this, Randy, okay.

11           Outside the loop, since the '99 survey, Marc  
12 look at that number, you're doing good. Only a 52  
13 percent increase since 1995, okay.

14           In my humble opinion, the largest factor for  
15 success was the quality of the engineering design. You  
16 don't have to put a lot of stuff inside the building to  
17 get these things to work, but you do need a very, very,  
18 very good ground loop. And I think that's it.

19           MR. LOYER: Thank you, Doctor.

20           MS. MELINE: Well, it's kind of tough following  
21 a pro there, somebody who taught for a living. In any  
22 event, I wanted to kind of wrap this up, to kind of  
23 follow on that discussion about Energy Pro -- or Energy  
24 Star.

25           There was legislation passed back in 2007, AB

1 1103, and what that required was that all nonresidential  
2 buildings greater than 5,000 square feet are supposed to  
3 be benchmarked.

4           There's been some delays in that and the latest  
5 rulings are listed on the bottom of this slide. But,  
6 basically, what we're trying to do is get building  
7 owners to rate their buildings using this Energy Star  
8 software that Steve was talking about. I believe it's  
9 called Portfolio Manager. And they need to disclose the  
10 Statement of Energy Performance to the California Energy  
11 Commission.

12           Joe says maybe, maybe not.

13           So, in any event, you know, this is something  
14 that, you know, we're supposed to be doing, anyway, we  
15 should be using Energy Star.

16           Now, I believe -- obviously, this is  
17 nonresidential, so we're looking at commercial. It  
18 excludes, I believe, multi-family housing.

19           But right now, as the rules currently stand,  
20 pretty much any building greater than 10,000 square feet  
21 is supposed to be benchmarked.

22           The buildings that were 50,000 square feet or  
23 greater were supposed to -- it was supposed to be  
24 January, but they've let that slip back to July, so  
25 there's some time. And then your smaller building --

1 smaller building owners are required to do that for  
2 buildings between 5,000 and just under 10,000 square  
3 feet by the beginning of this next year.

4           So, you know, really, when I was preparing for  
5 this I looked around a little bit and we're actually  
6 doing a pretty darn good job. They've got Los Angeles  
7 ranked first in the nation for benchmarking buildings.  
8 So, yay, the good news is that California is already  
9 doing this.

10           So, why am I bringing it up? Well, I think we  
11 probably want to do this on a greater scale and get some  
12 of these buildings that we have in California with the  
13 geothermal heat pump systems; we need to get them into  
14 the system and see how we're doing.

15           This is a colleague of ours, from ASHRAE. He's  
16 been doing a lot of schools in Illinois and Missouri.  
17 And here's something I pulled right off of his website.  
18 It's a discussion of this particular school. You'll see  
19 at the bottom there he got a 97 Energy Star rating.

20           Just to give you a little background on the  
21 building, itself, it was a school that was originally  
22 designed to have heat, only, with a steam boiler, and it  
23 was providing heat to each of the classrooms and all of  
24 the spaces with unit heaters, unit ventilators.

25           He went back in and retrofitted the system with

1 a geothermal heat pump system, provided individual heat  
2 pumps for all of the classrooms and the different  
3 spaces, and provided both heating and cooling to that  
4 school, okay.

5           Granted, there was a huge energy savings, but  
6 what I want to do is give you a picture of that. If you  
7 look at this chart here you'll see this red line here,  
8 that was the energy consumption for the entire building,  
9 lighting, computers, heating, boiler. Obviously, I did  
10 convert the gas and electricity to one unit of measure.  
11 This is all in KBTUs, or 1,000 Btus per square foot of  
12 this particular school.

13           So, what you have here is the peak during 2006  
14 was like 17 KBTU per square foot. The year after that,  
15 2007, they peaked at 20. The year after they installed  
16 all of those geothermal heat pump systems and provided  
17 both heating and cooling to this school, check this out,  
18 why can't we do that here? That's amazing to me.

19           Now, granted, this is Illinois and Missouri, but  
20 I think that's really something that we should try to do  
21 here.

22           And so, I had mentioned that there were some  
23 projects that have been installed in the State of  
24 California. We're doing it on a limited basis. We are  
25 doing some community colleges. This is up in San

1 Francisco -- or down in San Francisco. We're doing lots  
2 of residential but, unfortunately, they don't really fit  
3 into this Energy Star model that I'm talking about.

4           We've got a prison outside of Fresno.  
5 Restaurants, we've got some office buildings, wineries  
6 in the North Bay. And, yes, you can even do this up in  
7 Tahoe. I mean, this particular project, I've been up  
8 and looked at the ground temperature, and in the  
9 wintertime it's like 45 degrees. So, you know there's  
10 some efficiency going on in this building, but we're not  
11 capturing it.

12           I like to show this slide because this was a  
13 visitor's center and I actually have the energy data on  
14 this project but, unfortunately, museums and visitor  
15 centers aren't really covered by Energy Star. There's  
16 12 different building types that do apply so, you know,  
17 we'd have to go out and seek those.

18           But this is a picture of when we were putting  
19 the ground loop in, geez, four years ago, now, almost.  
20 Hot, 105 degrees in April, out in the desert, here's how  
21 it looks now. This was a picture that was taken two  
22 years ago and that's my ground loop out there, under  
23 that beautifully landscaped, with recycled water,  
24 facility.

25           So, again, let's take a look at the data. Let's

1 go collect this. Let's look at some buildings. Both,  
2 you know, compare how these buildings with geothermal  
3 heat pump systems are benchmarked against other  
4 buildings that are already in the system, let's see how  
5 we're doing.

6           What I would like to propose is, you know, why  
7 do the Energy Star? I think -- I think we need to  
8 comply with the legislation that's out there. I think  
9 it's a pretty straight forward way to collect this data.  
10 It's not perfect but, you know, we're comparing like  
11 buildings against like data, in the same region.

12           I think we want to benchmark geothermal heat  
13 pump systems against other types of systems because  
14 there are other types of systems that are also  
15 efficient, right, but we need to know how we're really  
16 doing.

17           And the problem that we've encountered, and as  
18 you see not just in California, but across the  
19 industries, we just don't have data, so this is a way  
20 for us to capture some data to start seeing how we're  
21 doing.

22           I would like to work on creating some kind of a  
23 project format with CaliforniaGeo being the repository  
24 of this information. And the reason for doing that is,  
25 well, that's what we'd like to do as an industry is have

1 that data available.

2 But we want to help the public make informed  
3 choices about, you know, how different systems perform.  
4 And, obviously, we would like to see more of this  
5 technology as an option for people to consider.

6 But, you know, they can also get an idea of  
7 which engineers, and contractors, and drillers are  
8 putting in the better systems.

9 In that article that I showed you previously,  
10 the first page that Steve and I -- well, mostly Steve  
11 wrote, I just kind of co-authored with him a little bit,  
12 gave some input, this is a format that he had proposed  
13 that engineers put together to showcase their projects  
14 and build a portfolio.

15 Now, there's a lot of information here. It's  
16 more information than what the Energy Star proposes  
17 because it has a lot of the cost data here, but I think  
18 this is a nice target. I mean, this is the kind of  
19 information that people want. They want to know how  
20 much does it cost, how much am I going to save. And so  
21 this, I think, should be the goal, this is where we want  
22 to head with collecting this data.

23 And I think that's about all I have to say for  
24 that. So, thank you. Joe, I'll turn it back over to  
25 you.

1 MR. LOYER: Thank you, Lisa. Thank you, Doctor.

2 I think what we'd like to do know, we are just  
3 running perfect on time, it's amazing. I think what  
4 we'd like to do now is sit our first panel, if we may.  
5 Unless we would like to open it up to questions, now. I  
6 think the panel would probably be the more appropriate  
7 way to do that. What do you think, Phil?

8 MR. LOYER: Well, I have them listed up here.  
9 It's, you know, quite a few. I would say about 15, 16.  
10 I'm seeing no raised hands. There is one call-in and I  
11 can unmute them.

12 But, first, let me turn to the room. Is there  
13 anybody who'd like to ask a question of either -- yeah,  
14 Dan.

15 MR. BERGOYNE: Dan Bergoyne, I'm with DGS. I  
16 had a question about the effectiveness of the heat pump  
17 in a hot climate, like in the Central Valley. You'd  
18 mentioned it's best if you have balanced heating and  
19 cooling needs, and how effective is it or how much  
20 effectiveness do you lose in a warmer climate, where  
21 it's mostly a cooling load?

22 MS. MELINE: So, that one example that I had on  
23 the slides, out in the desert, obviously, in a lot of  
24 those places the ground loop -- the ground temperature  
25 is warmer. So, as long as you're taking that into

1 account with your design, you will be fine.

2           You can deal with the imbalance by putting more  
3 loop into the ground, which is obviously going to be,  
4 you know, a cost, or you can look at a hybrid system  
5 where you would -- in that particular case you could put  
6 a cooling tower, fluid cooler in to help with that heat  
7 rejection, which would bring that system into balance.

8           On that particular project the owner decided  
9 that they didn't want to have to deal with the cooling  
10 tower. Obviously, one of them is water because it is  
11 out in the desert, and the other thing is that they have  
12 a lot of sand storms and things like that and they  
13 didn't want to have to deal with the maintenance issues  
14 that are often created with cooling towers.

15           So, on that particular project we had a lot more  
16 borehole per ton in installed equipment capacity than  
17 you might have for that same facility, say, in the Bay  
18 Area. So, that's how we would do that.

19           Because, in reality, the technology works pretty  
20 much everywhere in California except in Region 16, where  
21 you have a lot of hot water geothermal activity for  
22 power generation.

23           The tradeoff is what the design is, the cost of  
24 that design, the cost of energy and how much that  
25 system's used. And so, those are the things that you

1 have to look at and that's kind of like part of that  
2 lifecycle cost.

3 You might want to be up here.

4 MR. LOYER: Okay, are there any other questions?

5 MR. OMAR: Reuben Omar, Mitsubishi Electric. I  
6 had a question regarding open loop systems and wanted to  
7 know a little more what are the challenges for those,  
8 since they seem to have at least a high potential for  
9 reducing the initial cost.

10 MS. MELINE: Well, the challenge with open loops  
11 in California is that typically you would get a well  
12 permit from the county. And you have to do something  
13 with that water, you have to discharge it, you have to  
14 put it back into the aquifer. Somehow you need to  
15 manage the discharge. And that's a separate permit  
16 through the Regional Water Quality Control Agencies  
17 across the State, I believe there are nine total.

18 So, first of all, you have the issue of water  
19 and where are you going to put that water after you've  
20 used it and, second of all, the permitting is a  
21 challenge.

22 Now, I have done a couple of these projects.  
23 Typically, they have been around for a long time so  
24 they've been grandfathered and allowed, but they're  
25 highly unusual, really, as a ground application,

1 groundwater application here.

2 MR. LOYER: The question was have you looked at  
3 landscaping for possible use of that water?

4 MS. MELINE: Again, I actually just had a  
5 project permitted here in Sacramento, it was on the  
6 River Road, and it was allowed because the owner of this  
7 home was going to discharge that water into his  
8 landscaping. So, you can do it, but you have to go  
9 through the permit process and it's up to that Regional  
10 Board to tell you whether or not they're going to allow  
11 you to discharge that water and how to do it.

12 MR. KAVANAUGH: One of the things that you do  
13 with ground source heat pumps is you look at your site,  
14 okay. And I'm supposed to be the person who's like the  
15 expert in closed loop systems, but my lab is heated and  
16 cooled with an open loop system. It was, at this  
17 particular site, a much, much better option.

18 The issues are, and part of your looking at the  
19 perspective is the local regulatory environment, which  
20 this happens to be one of the strictest that limits  
21 that, that's really -- but from a technological stand  
22 point, the issue is that with a groundwater system the  
23 costs are significantly lower the larger the building  
24 gets, just the return on it.

25 The other issues that a lot of the times

1 engineers don't understand is they pump too much water  
2 out of the ground, okay. Typically, when we're  
3 circulating through the interior of the building we want  
4 to see two and a half to three GPM per ton on the inside  
5 of the building.

6           Whereas with groundwater, if it's way down deep  
7 and you're trying to pump three GPM per ton your  
8 efficiency goes to pot, okay.

9           So, we like to see the groundwater isolated from  
10 the building water loop with a plate heat exchanger of  
11 some kind.

12           And at my particular application, where my lab  
13 is, it was really easy to do this, very hard to install  
14 a closed loop system.

15           So, you've got to look at what's around you.  
16 But as far as groundwater systems, a little bit more  
17 maintenance, but not anything significant compared to  
18 closed loop systems.

19           MR. LOYER: Are there any more questions from  
20 the audience?

21           Okay, I don't see any hands raised on line here,  
22 but there is one call-in user and I'm just going to de-  
23 mute them very quickly here.

24           Hello, your label is Call-In User 5. Do you  
25 have any questions or are you online?

1           Okay, well, that sometimes happens.

2           Anyway, I think at this point, if there are no  
3 further questions, we'll seat the first panel. Unless,  
4 what do you think, should we break for lunch early?

5           Okay. All right, well, then if there aren't any  
6 more questions, we can break for lunch.

7           Oh, I do -- I forgot, I do have one question  
8 from our Commissioner. And it's Commissioner  
9 McAllister. And, basically, he said, "What are the  
10 operating conditions and characteristics for both the  
11 site and building loads where ground source heat pumps  
12 is most appropriate?"

13           And I think we've answered that question very  
14 effectively with these presentations.

15           But I think the second part is, "Where in  
16 California do those conditions -- are they most  
17 prevalent?"

18           And I think one of the things that comes to my  
19 mind is when we talk about both the heating and cooling  
20 load requirements. And when we look at California, most  
21 of California is a cooling load. The Central Valley --  
22 the Central Valleys are both heating and cooling. Our  
23 mountain regions are both really primarily heating, but  
24 both heating and cooling.

25           But when we look on our coastal systems, if we

1 look in, say, the San Francisco Bay Area, particularly  
2 on the coast, we're primarily a heating dominated area  
3 there.

4           So, I think what the Commissioner would like to  
5 know is are there -- it's not really where is it  
6 applicable, but where is it really not applicable in  
7 California?

8           MS. MELINE: Well, you know, my first obvious  
9 response to that is areas where you don't have favorable  
10 ground condition and that's going to be, you know, like  
11 Calistoga, where you've got geothermal hot water below.  
12 You know, you just don't have the favorable ground  
13 temperature that you would, say, in the Sacramento  
14 Valley. So, that's kind of -- in most cases that's the  
15 only deterrent I would see as far as where you wouldn't  
16 do it.

17           Now, there are situations where it typically is  
18 more favorable, like locations where you look at the  
19 energy costs. So, places where your only options are  
20 all electrical power, all electricity, or electricity  
21 and propane, because propane and other alternative gas  
22 type fuels are much more expensive than natural gas.  
23 Right now, natural gas is very cheap.

24           So, when you have situations where you have  
25 natural gas and you have a lot of heating, it's a little

1 bit more challenging to show significant savings, like  
2 you would see on the air conditioning side where you  
3 have -- you know, I can almost tell you, without doing  
4 an analysis, you're going to see at least a 30, 35  
5 percent savings.

6 So, again, like Steve said, you have to look at  
7 the site, and the building, and how it's used, and the  
8 cost of energy, and there's a lot of things that factor  
9 into whether or not it makes sense. Because, really, it  
10 can work anywhere, just how well and how cost effective.

11 MR. KAVANAUGH: One of the other things she  
12 mentioned, the building, and you'll notice that most of  
13 the -- a large percentage of the sites we've monitored  
14 were schools, okay.

15 So, another thing that affects, in the  
16 commercial sector, the applicability is the building,  
17 itself. A school, in a cooling-dominated climate, often  
18 is not going to be used for 10, 12 weeks in the summer,  
19 so the load goes down.

20 But more importantly, if California's anything  
21 like Alabama, you know, if we can draw any comparisons  
22 between those two states, is that schools can be built.  
23 There seems to always be funding for building schools,  
24 okay. But there's not much in the way of operating  
25 schools. Those budgets are getting cut.

1           One of the things that we saw in our survey,  
2 that the HVAC technicians, they average about five  
3 schools per HVAC technician. That's humongous, one  
4 technician for every five or six schools, okay. So you  
5 don't have the budget to maintain and operate the  
6 schools, but you have the budget to do it.

7           So, what you do is you do a simple closed loop  
8 system, without a lot of these controls, or these fancy  
9 heat pumps or anything, just a simple system that can be  
10 maintained by one guy covering five schools.

11           MR. LOYER: Here you go.

12           MR. HENRY: Yeah, nice to have a microphone in  
13 my hand. To the Commissioner's question, there's two  
14 pieces of this from my perspective. One is where does  
15 the technology work, right, and I think we should figure  
16 out how to put to bed that that's not a fundamental  
17 issue. It works, essentially, pole to pole, with very  
18 few exceptions.

19           What the other side of the question is, is the  
20 economics. That's a budgetary issue. And only the  
21 project owner and the design team can really make that  
22 determination, you know.

23           It's somewhat akin to the old Pennzoil  
24 commercial. If you're doing heating and cooling, you  
25 know, you're paying for a maybe more expensive

1 technology every month that you write out a check for  
2 the utility bill.

3 So, what it comes down to is how do you get the  
4 benefits that you need with certain budgetary  
5 restrictions. And fortunately, in California now, I  
6 think we're moving to an era where, as a society, we're  
7 starting to put dollars into making those investments  
8 that will serve us over the long term.

9 And there is actually a -- I'm not sure where it  
10 is in the approval process, but there's a PIER Program  
11 study, it's being done by the California Geothermal  
12 Energy Collaborative, right. I forget the title of it  
13 but, yeah, the preliminary -- it's a CEC-sponsored  
14 project.

15 The preliminary results suggest that when  
16 looking at just a model residence in all 16 climate  
17 zones, with the closed loop ground heat exchanger, the  
18 average savings was 44 point some percent. And there  
19 was some place where the savings kind of fell off the  
20 bottom of the curve, and that was in climate zone 16, I  
21 believe, and that was due to the high ground temp so --

22 MR. LOYER: Thank you.

23 Are there any more questions from -- yeah,  
24 please.

25 MS. GOLDBERG: Hi, Sandy Goldberg. I just

1 wanted to make a comment on that issue. There are many  
2 counties, you'd be surprised, in California, where they  
3 do not have deliveries of natural gas, there's no  
4 infrastructure. Like Plumas, Sierra, Lassen, Shasta  
5 might be really excellent locations for ground source  
6 heat pump for heating, even if they -- well, they  
7 probably have cooling loads in the summer but, I mean,  
8 even if a school doesn't really need it for cooling.

9 MR. LOYER: I might just mention that we have  
10 year-round schools here in California. And I might also  
11 point out that just recently we've actually gone  
12 through -- in the Central Valley we've gone through some  
13 school closures that were fairly painful, and here in  
14 Sacramento, so, a few of us here that live here are  
15 aware of that one.

16 Are there any other questions or comments?

17 All right, with that let me just check online  
18 real quick. And I don't see any hands raised online.

19 Then we can, I think, break for lunch. I think  
20 it was a great session. And we can come back at 1:00  
21 p.m. Thank you very much.

22 (Off the record at 11:35 a.m.)

23 (Resume at 1:00 p.m.)

24 MR. LOYER: Okay, we're coming back now. And  
25 we're going to start Session 2 here, and we're doing

1 quite well on time.

2           So, I'm going to turn this over to Paul Bony,  
3 who is the Director of Residential Marketing,  
4 Development, and Western Regional Sales for  
5 ClimateMaster. Thank you, Paul.

6           MR. BONY: Thank you. And I'm going to talk  
7 about one of my favorite topics which, because it's been  
8 the evolution of my utility curve before I went to work  
9 for a manufacturer, as we do more and more renewables,  
10 and more and more on efficiency that's really driving us  
11 to net zero buildings which, of course, is a statutory  
12 requirement in California.

13           So, my topic today was "Geothermal Heat Pumps  
14 Systems Potential for California Net Zero Buildings,"  
15 which I thought was kind of boring.

16           So I changed that a little bit for you all today  
17 and I'm calling it, "Geothermal Heat Pumps a Key  
18 Ingredient in a Net Zero - Low Carbon Diet" because I  
19 had the low-carb diet at lunch today with -- so it would  
20 fit.

21           And we're kind of here in the Gold Rush country,  
22 so I love Mark Twain's quote on diet, "Part of the  
23 secret of success in life is to eat what you like and  
24 let the food fight it out inside."

25           And I'm convinced that if we bring ground source

1 heat pumps, energy efficiency, and on-site renewable  
2 generation together the food doesn't even have to fight,  
3 it's just going to work. So, that's what we're going to  
4 talk about for a few minutes today.

5           So, California's at the cusp of this really  
6 exciting building, this kind of bringing together of  
7 building science, renewable energy, and ground source  
8 heat pumps where the efficient envelope, the super-  
9 efficient ground source heat pump equipment, and we'll  
10 talk about that in a little more detail, and renewable  
11 energy systems are almost what we need in that diet to  
12 get to net zero.

13           But there are some other things that are going  
14 on in the space that will make that happen. One of  
15 which is these -- some financing tools I'm going to talk  
16 about, and then we'll talk a little bit later today by  
17 how those can actually be brought to the table by  
18 utility companies.

19           And then some policy issues that if we just put  
20 that last ingredient in there we can really bake a net  
21 zero cake that really works for the State, and get to  
22 this point where buildings truly to produce enough  
23 energy on site -- as much energy on site as they  
24 consume.

25           So, quick definition, and I know there's another

1 workshop coming up in a month from now, but zero energy  
2 buildings use no more energy over the course of a year  
3 than they produce from on-site renewable sources.

4           And obvious to that is the fact that it's really  
5 tough to produce natural gas, oil, and propane on site.  
6 So, you have to address the thermal loads of buildings  
7 to get to true zero energy.

8           And I'm convinced, and I've been doing this for  
9 20 some years now, that we do have all the ingredients  
10 we need to get to zero energy buildings without a whole  
11 bunch of whiz-bang, incremental stuff for many common  
12 building types.

13           And the New Building Institute, about this time  
14 last year, did a study that say they agree with me, so I  
15 was happy to see that we're on the same wave length  
16 there. That was a bit of post-lunch humor there, for  
17 those of you who are --

18           So, really, we're coming to this point where  
19 ground source heat pumps and on-site generation like  
20 solar photovoltaic really are kind of peanut butter and  
21 chocolate together. They really do come together in a  
22 nice way.

23           The paybacks from ground source heat pumps  
24 actually help offset the cost of solar systems and you  
25 can -- you really can, by taking the thermal loads of a

1 building offline with ground source heat pumps. Now,  
2 you have a footprint that's small enough that you can  
3 produce that net energy on site. And then the thermal  
4 loads are the piece that needs to be addressed.

5           And so that there is a limit to PV or on-site  
6 electric generation so -- so another study, if every  
7 home had PV, it still wouldn't be enough to get to net  
8 zero, because the PV doesn't address the single biggest  
9 use in the house, which is space heating, space cooling,  
10 and water heating.

11           So, now, you put ground source heat pumps on  
12 that so that heating, ventilating and air conditioning  
13 system gets its thermal energy from the ground, the PV  
14 generates the electricity.

15           And the other thing that ground source heat  
16 pumps do, because they're a water-based system, is they  
17 allow the ability to store and harvest thermal energy  
18 when you need it. So, you can actually move the thermal  
19 energy. You may have excess thermal energy and you can  
20 move it to another time of the day when you do need it.

21           So, that water storage and that ability to store  
22 and move BTUs is critical. And that becomes the perfect  
23 mix for net zero or near zero buildings.

24           So, how does that work? Well, you've heard  
25 earlier today if a ground source heat pump takes 50

1 percent of the total load of the building offline,  
2 obviously, you're that much closer to getting to net  
3 zero.

4           And then, if you can use the grid as a battery  
5 that helps you move those peaks back and forth. And the  
6 most important thing is that you can offset the natural  
7 gas, or propane, or fuel oil, or other thermal loads.

8           We're at this cusp where PV and solar thermal  
9 are coming together, and I'll talk just a little bit  
10 about that. So, now, you're actually -- you can use  
11 that rooftop space to not only make electricity, but to  
12 make thermal energy. So, in heating-dominated climates  
13 now you've got the best of everything. You've got  
14 renewable thermal energy combined with a ground source  
15 heat pump, combined with using the ground as a storage  
16 center, combined with on-site electric generation.

17           And this is just a picture of one of the net  
18 zero houses that's out there that actually incorporates  
19 that.

20           So, you can't get to net zero without a ground  
21 source heat pump. You can't get there cost effectively.  
22 And we can talk a little bit -- you saw some of the data  
23 on SEER and EER, which is another one of my favorite  
24 topics.

25           You can't have a real high needle peak on the

1 summer and have enough PV to offset it.

2 But if you have a ground source heat pump with a  
3 high EER, that needle peak goes away.

4 And so, air source equipment, other compressor-  
5 driven technologies that aren't water based just don't  
6 have the cost-to-benefit ratio to match the on-site  
7 generation. And so, you've got to get away from that  
8 needle peak and ground source heat pumps by using the  
9 constant temperature of the earth to do that.

10 And you can't store energy in the air and get it  
11 back. However, you can store excess energy in the  
12 ground loop and take it back out later in the season,  
13 later in the evening, later in the day.

14 So, the loop, the water, the earth all come  
15 together to make this thermal battery that gets rid of  
16 those needle peaks and it really lets you manage your  
17 thermal loads better.

18 So, you know, when we talk about net zero it's  
19 important to realize that even if renewable energy  
20 supplied 80 percent of all of our electric generation in  
21 the country, it wouldn't be enough to meet the carbon  
22 goals that we've established because you have to address  
23 the thermal loads, okay.

24 And so, simple chart on that, and this chart's  
25 been around forever. Thermal loads, heating, cooling

1 and hot water are about 20 percent of our society's  
2 carbon emissions and they're about 17 percent of the  
3 total -- you can see the primary energy consumptions  
4 there.

5           And one of the flyers I noticed that you have  
6 today shows how much natural gas is used for heating and  
7 water heating in California. And you can't get to net  
8 zero if you're using natural gas to generate those  
9 sources.

10           So, you put a ground source heat pump on a  
11 building and you can see that this is a national average  
12 here. the heating, and air conditioning, and water  
13 heating shrink from over 60 percent of the building's  
14 load to you take 49, 50 percent of those loads offline.

15           So, now, you're renewable on-site generation  
16 just has to address what's left. And I'm convinced that  
17 if we combine that with solar thermal, then that hot  
18 water use of six percent of what's left can go away, the  
19 remaining heating can go away because you've  
20 supplemented it with solar thermal. And, really, what  
21 you're left with is a little bit of electricity for the  
22 air conditioning and then your lighting, and appliances.

23           And then, so that kind of gets to these policy  
24 issues that need to change a little bit. So, we have to  
25 get our head around the fact that we're moving away from

1 high-carbon generation sources, burning high-carbon  
2 fuels to make electricity.

3           We really need to wrap our heads around why  
4 would we use high-carbon sources to heat our buildings  
5 and heat our hot water when you can have -- if we have  
6 carbon-free electricity, we can have carbon-free space  
7 conditioning and we can have carbon-free water heating.

8           And so that's the last big policy gap to get to  
9 no carbon in our society.

10           I'm from Colorado, so I have -- I'm pretty  
11 confident with my math in Colorado, haven't done this  
12 for California, although it certainly would be an easy  
13 thing to do.

14           I want to share with you that if we took an  
15 average home in Colorado and we quit burning gas in the  
16 furnace to make heating, we would actually be able to  
17 use that gas in a high-efficiency turbine and end up  
18 with more kilowatt hours for the same amount of gas than  
19 the house would use with a ground source heat pump to  
20 100 percent of the space conditioning.

21           So, let me stop there for a second. In heating-  
22 dominated climates, a ground source heat pump will cut  
23 summer kilowatt hour usages, it will cut summer peak  
24 demand usage by a lot, but it will use more kilowatt  
25 hours over the course of the year.

1           However, the gas that you would burn to make  
2 that space heating in Colorado, if you ran that through  
3 an efficient gas turbine, a combined cycle turbine, you  
4 would actually end up with more kilowatt hours from  
5 using the gas in the turbine than you do by making space  
6 heating in the house, okay.

7           So, it really leverages the use of that fossil  
8 fuel for generation instead of basically burning it and  
9 putting it up the chimney.

10           And then, this is my SEER/EER slide. Basically,  
11 it addresses that utility needle peak issue. When it's  
12 105 degrees in Sacramento, those high SEER units are  
13 delivering low EER performance.

14           And the ground source heat pump also decays a  
15 little bit because the water -- the entering water  
16 temperature is a little higher later in the season, but  
17 the order of magnitude is not near as great.

18           So, if you don't want utility needle peaks, you  
19 have to use water source equipment, and SEER programs  
20 are not going to get you to eliminating those peaks.

21           If you want to have on-site generation, do you  
22 want to pay for a PV system that meets the hottest three  
23 days of the year, at an EER of 8 or 9, or do you want to  
24 base it on a ground source heat pump system that has an  
25 EER of 12, 13, 14. So, it's really that -- that's how

1 ground source heat pumps eliminate and leverage those  
2 needle peaks that come from air source equipment.

3           So, Xiaobing Liu was going to be here today, and  
4 Phil's going to fill in for him. But Oakridge did a  
5 really nice study in 2010, on a national basis, and  
6 ground source heat pumps and when they look at it across  
7 the country reduced total energy consumption for  
8 heating, cooling, and domestic hot water by 45 percent,  
9 reduced peak energy demand by 56 percent, reduced  
10 consumer bills by 48 percent, and then reduced carbon  
11 emissions by 45 percent.

12           California's going to be a little different than  
13 the national average, but there's also multiple climate  
14 zones in California. So, Northern California and the  
15 Sierras, where I used to live, are going to be different  
16 than San Diego.

17           But at the end of the day, ground source heat  
18 pumps take about 50 percent of peak, 50 percent of total  
19 energy and save customers' bills by about 50 percent.

20           So, this is that nexus I was talking about.  
21 This is a Colorado-based company. The equipment on the  
22 right there is actually a solar PV/solar thermal piece  
23 of equipment.

24           So, that little array, four heads that you see  
25 there, so 16 panels, is a 10 KW thermal equivalent

1 system, 4 KW of electric generation, 6 KW of thermal  
2 generation. And it takes up that much space. It's  
3 about a 10 by 10 array.

4 That is a single house worth of solar thermal  
5 and annual kilowatt hour production. So, that takes  
6 that last little bit of hot water offline, reduces that  
7 space heating in northern climates.

8 So, we're there. There are several companies in  
9 the states that are to the point where they're making  
10 electricity and solar thermal with the same equipment,  
11 so you pay for it once and you get both benefits.

12 And then this goes to the storage. It's not to  
13 scale. The loop field's on the far left. But,  
14 basically, water's a very cheap medium to store energy.  
15 So, if the wind's blowing at three o'clock in the  
16 morning, you can pre-chill water and store it in the  
17 tank to take it off in the afternoon, when the wind quit  
18 blowing and the renewable generation's coming offline.

19 But for every degree of reduction in entering  
20 water temperature in air conditionings you pick up about  
21 a percent of efficiency on space cooling.

22 Also, you can do that seasonally. The  
23 University of Colorado just received a couple million  
24 dollar grant from the National Science Foundation to  
25 start building the algorithms to use ground loops as the

1 thermal storage medium for renewable energy.

2 Now, if you've paid for your loop, it's an  
3 embedded cost, why not pre-heat it, pre-cool it so that  
4 you can get greater efficiency when you need it later in  
5 the day or later in the season.

6 The Europeans do a lot of that. They actually  
7 have buildings with two loop fields. They have a loop  
8 that in the summer they're basically storing heat in it  
9 so that they can take it out in the winter. In the  
10 winter, they have another loop field that they're making  
11 colder so they can use that even colder loop water for  
12 air conditioning in the summer.

13 So, you're paying for your infrastructure once,  
14 you're using it twice.

15 And as the grid becomes -- has less and less  
16 carbon in it, so as we have more and more renewable  
17 energy, more lower-carbon sources for generation when we  
18 do space conditioning and water heating with low-carbon  
19 electricity, which is what ground source heat pumps use  
20 electricity to run, basically, that drives us to true  
21 net zero as a system.

22 Ground source heat pumps are scalable. These  
23 are Habitat for Humanity homes in Oklahoma City, little  
24 1,300 square foot homes.

25 The solar panels on these houses were about half

1 the size that they needed to be true net zero, but here  
2 are the results of those houses.

3 And, by the way, it incorporates everything that  
4 I think you need to get to net zero; super-efficient  
5 building envelopes, ground source heat pumps, and then  
6 some of the houses Habitat put PV on the roof.

7 The loops for these houses are actually under  
8 the furnace, one loop per house, directly below the  
9 ground source heat pump.

10 So, look at the energy savings as you follow  
11 down to the right is basically the houses they were  
12 building before, which was a standard air conditioner  
13 and gas furnace. Then they did shell improvements, and  
14 they put in a ground source heat pump, and then they put  
15 a little PV on the roof.

16 So, if you can see, the PV in this case is  
17 generating 11 units of energy and the net is still 19.  
18 Now, combine solar thermal with that, so the water  
19 heating comes offline, and you can see each of those  
20 individually, so that's six or seven units that would  
21 come off if you made solar thermal while you're making  
22 solar electric. Those are almost net zero homes and  
23 they're cost-effective, Habitat for Humanity, little  
24 houses in Oklahoma.

25 So, the takeaways on this kind of -- this little

1 session are ground source heat pumps are the most  
2 efficient and cost-effective method to heat and cool a  
3 building, period.

4           They are renewable and they're energy efficient.  
5 They can lever on-site solar and wind generation to a  
6 true net zero. They reduce utility peaks and improve  
7 factor. And in the next section I talk about, we'll talk  
8 about how that's important to utilities. And properly  
9 designed and installed they just -- they work.

10           So, I'm going to call this the intermission  
11 because I'm coming back after the next speaker, so thank  
12 you.

13           MR. LOYER: Thank you, Paul.

14           Let's see, next is Marc Hoeschele. Mark, I'm  
15 not sure which one of these is yours so -- this one?  
16 And you can step back here and run it from here.

17           MR. HOESCHELE: Thanks, Paul. That was a good  
18 presentation and kind of provides an overview.

19           My presentation is a little more California-  
20 focused, which is, you know, appropriate for today's  
21 session.

22           MR. LOYER: Marc, I kind of neglected to tell  
23 folks who you were and where you're from. Sorry about  
24 that.

25           MR. HOESCHELE: Okay, yeah. So, I'm with the

1 Davis Energy Group and we're a small consulting firm in  
2 Davis that's been around for about 30 plus years, that  
3 does a lot of energy efficiency work. Have done product  
4 development work, a lot of utility work. The Department  
5 of Energy Building America Program is another key part  
6 of our current work. And have been active in  
7 geothermal, although not that much lately.

8           The work today I'm going to talk about is a 2010  
9 study that we did for Pacific Gas & Electric that looked  
10 at geothermal technology as part of a zero net energy  
11 residential strategy.

12           So, to give a little background on Davis Energy  
13 Group and what we've done in the geothermal area, in the  
14 late '90s there were two Energy Commission projects that  
15 we worked on that did a lot of monitoring and modeling  
16 using DOE-2 on geothermal homes in the SMUD and Truckee  
17 Donner service areas.

18           And the monitoring, we did very detailed  
19 monitoring on system performance, both on the air side,  
20 the delivery side, and the water side of the systems.  
21 We used that data to calibrate ground loop models to be  
22 used in DOE-2.

23           And the second study was interesting, too, in  
24 that we dealt with some of the installations in both  
25 service territories that had issues and there was some

1 remediation work done partway through the project so we  
2 could assess pre- and post-impacts of improvements at  
3 these sites.

4           We also, in the late '90s, did a large project  
5 for PG&E that had a wide range of activities. The  
6 Geothermal Demonstration Program which, you know, pulled  
7 together, again, a wide spectrum of research areas, and  
8 more field monitoring work, case studies, primarily  
9 residential, but also on commercial products, looked at  
10 loop optimization, and modeling, and so forth, and  
11 developed Title 24 recommendations. So, that was a  
12 pretty broad effort.

13           Over the years, we're much less involved in  
14 design work, now, but we have done a few design  
15 projects, mainly residential, and currently working on a  
16 demonstration home that is going to be built on the West  
17 Village Campus -- or the University of California, Davis  
18 campus, and West Village is a zero net energy community,  
19 for those of you who aren't familiar. It will house  
20 about 3,000 people when it's complete. And so they're  
21 about halfway through with construction there.

22           So, the main focus today is on this PG&E study  
23 from 2010.

24           So, in this work, when PG&E was starting a more  
25 detailed, technical look at ZNE technologies, we were

1 hired to look at a few of the individual technologies  
2 that could be a component of a zero net energy home.

3 The original plans was to look at 25 various  
4 technologies, see how they fit, you know, as a component  
5 in terms of energy savings, source energy savings,  
6 customer economics.

7 The three we looked at were geothermal heat  
8 pumps, heat pump water heaters for domestic hot water  
9 and evaporative condensers, you know, that are more  
10 efficient cooling systems that have some traction out  
11 there.

12 The scope of the work included modeling the  
13 performance of these various system types, assessing the  
14 energy and demand impacts versus base cases. In this  
15 case we looked at both gas, furnace and heat pump as  
16 base cases, and evaluating the source energy impacts of  
17 these different options and, also, looking at customer  
18 economics under the current PG&E residential rates at  
19 that time.

20 And all of this was, you know, not taking into  
21 account any incentives in Federal tax credits because  
22 PG&E was looking at this as a longer-term piece and, you  
23 know, as the marketplace and the environment changes  
24 those incentives may or may not be there.

25 So, the methodology of the project, we did a

1 literature review, collected performance data on  
2 equipment, get pricing data from people operating in the  
3 field, selected a modeling tool to be used in the  
4 evaluation, which was the eQUEST model, which uses DOE-  
5 2.2 as the engine, developing simulation inputs to drive  
6 the model and baseline energy consumption that are, you  
7 know, critical in getting the billing -- the billing  
8 information right with the tiered PG&E rates we're  
9 dealing with.

10           So, we worked with the Residential Plan  
11 Saturation Survey Data that the Energy Commission is  
12 involved in producing every few years.

13           And then, also, Department of Energy has a  
14 Building America Benchmark protocol which, again, kind  
15 of also provided a lot of background information on  
16 building up, you know, these lighting, miscellaneous  
17 appliance loads that are a big part of energy bills in  
18 California.

19           We looked at three PG&E climates, the Bay Area,  
20 San Jose, and Fresno. And the rest of my study is going  
21 to focus on San Jose and Fresno. I mean, the Bay Area,  
22 basically we're just dealing with heating down there and  
23 just to keep things simpler, I'm focusing on those two.

24           And then we looked at three home types. An  
25 existing building, early '90s vintage house, a Title 24

1 new home, and a Tier 2 new home and that's under the New  
2 Solar Homes Program, and that's roughly 30 percent  
3 better than Title 24 at the time.

4           So, the input assumptions, as we modeling these  
5 homes, single story, roughly 1,800 square foot home,  
6 consistent with the saturation -- the Residential Plan  
7 Saturation Survey for average home size in California,  
8 single-family home.

9           Uniformly distributed glazing on the house and  
10 then the three home types we talked about.

11           And then with each of those vintages of homes we  
12 have varying envelope characteristics in terms of  
13 windows, insulation levels, equipment efficiencies, and  
14 so forth.

15           For furnace efficiencies, 80 percent AFUE  
16 standard for a new entry-level furnace, and then for the  
17 Tier 2 we also looked at high-performance condensing  
18 furnaces.

19           And heat pumps air source, Federal minimums for  
20 the base case and then a higher efficiency for the Tier  
21 2 case for the air source heat pump.

22           And then GHP, COP and EER assumptions as listed,  
23 and those values don't include the fan or pump energy.

24           So, you know, pulling back from Paul's  
25 information, kind of on a national basis, I mean

1 California has a, you know, slightly different energy  
2 picture, and especially as we're moving forward to ZNE,  
3 and just more efficient buildings as Title 24  
4 enhancements are seen in the marketplace.

5 We see a much lower -- these are modeling  
6 breakdowns, then, from our modeled HVAC performance and  
7 then, you know, building up all the other loads from the  
8 various inputs.

9 In climate zone 4, which is the San Jose area,  
10 we're looking at heating and cooling, slightly under 30  
11 percent of the total source energy budget of the house.

12 In the Fresno area, climate zone 13, it's 36  
13 percent.

14 You know, the work we've been doing in zero net  
15 energy and high-performance buildings, I mean,  
16 increasingly the appliance and miscellaneous piece and  
17 lighting are the bigger pieces that are going to be  
18 challenging to address. So, you know, those are  
19 certainly key factors to look at.

20 The completion of the modeling, this graph,  
21 then, on the space conditioning source energy savings on  
22 the Y axis and then on the X axis we have the two  
23 climate regions. On the left San Jose, right Fresno,  
24 and then the three building types so, the Title 24  
25 existing and the Tier 2 home.

1           The blue bars represent the source energy  
2 savings for the geothermal system relative to the gas  
3 furnace-based case, and the red bars to the heat pump-  
4 based case.

5           And as we go from the Title 4 and existing to  
6 the Tier 2, we do have an increased efficiency of the  
7 base-case system that is assumed, so we see slightly  
8 reduced impacts there.

9           For the gas furnace cases we're looking at  
10 roughly 30 to slightly over 40 percent source energy  
11 savings. For the heat pump cases, a little bit higher,  
12 35 to 45.

13           The one slight flip flop here on the Tier 2  
14 Fresno, the heat pump, the nature of the load patterns  
15 with the Tier 2 home causes the heat pump case projected  
16 to be slightly -- the source energy impact to be  
17 slightly smaller than the gas furnace case.

18           So, now, we get into some of the challenging  
19 things we find in California. And, you know, the  
20 primary barrier or what makes California unique is  
21 across the country on residential, retail rates, the  
22 relative ratio of those rates in California are -- you  
23 know, the electric, the gas ratio is among the highest  
24 in the country. So, that's clearly a burden for the  
25 customer the way the rates are.

1           Low natural gas rates, which we're going to have  
2 for some period of time. How long, we're not sure.

3           But, so the impacts of that are reflected here  
4 on the left-hand side when we're showing the annual  
5 projected PG&E utility bill savings for the geothermal  
6 system, for the different housing types, and climate  
7 zones.

8           So, these are -- these rates are calculated  
9 using the tiered electric rates that PG&E has and, you  
10 know, utilizing the monthly energy used, both gas and  
11 electric that came out of the model.

12           So, we see in climate zone 4, in San Jose, the  
13 geothermal on the Title 24 and existing will actually  
14 cost slightly more to operate, and in Tier 2 a small  
15 credit but, essentially, no cost savings there.

16           Versus a heat pump, the savings are definitely  
17 more favorable. Tier 2 they're diminished because the  
18 space conditioning loads are reduced and the impact of  
19 the tiers.

20           Climate zone 13, in Fresno, where we have much  
21 higher cooling loads than in the San Jose area, the  
22 benefit of the cooling reduction is more apparent there  
23 as we see savings going -- for the existing and Title 24  
24 going from two to eight hundred dollars.

25           On the right are the incremental GHP cost

1 assumptions, again, no Federal tax credit or any other  
2 incentive shown in this, so that's relative to the base  
3 case for that situation.

4           The lower end of the range would be the Tier 2  
5 home incremental costs as the systems are smaller, and  
6 the high end are for the existing home cases, where the  
7 system is larger, and the ground loop.

8           So, conclusions from this study, for the climate  
9 zones we looked at, the three, heating and cooling is  
10 roughly about 30 percent of household source energy  
11 consumption for the buildings as modeled.

12           In terms of the performance side of things,  
13 we're looking at, you know, reductions. The next three  
14 bullets are kind of looking at the different base case  
15 systems; we're looking at reductions of 30 to 45  
16 percent.

17           Source energy in heating and cooling, with  
18 corresponding whole-house source energy reductions of 7  
19 to 12 percent and, you know, that's diluted somewhat by  
20 the fact that the other end uses are a significant part  
21 of the energy bills in California homes.

22           Summer demand savings, 27 to 39 percent,  
23 higher -- higher demand savings for the new and existing  
24 homes that have higher peak demands than the Tier 2  
25 homes.

1           And higher cooling loads clearly improve  
2 geothermal economics because then we're not burdened by  
3 the relative, the natural gas to electric cost situation  
4 that we have in California or in PG&E specifically.

5           So, those favorable energy projections are kind  
6 of dampened by, you know, the situation that costs are  
7 high in California and savings are not that optimistic  
8 in many scenarios, so the economics are not good.

9           Now, clearly, there are -- you know, we were  
10 dealing with, you know, representing average consumption  
11 patterns, kind of a mid-point. And there are,  
12 certainly, you know, higher users in certain situations  
13 and then when you get to the electric heater or propane  
14 customers which wasn't part of this study, there's an  
15 entirely different set of conclusions.

16           But looking at the vast bulk of, you know, PG&E  
17 customers, these were the findings.

18           The tiered electric rates are clearly a problem.  
19 As -- you know, as we do want more load for the system  
20 to work against because from the load we get savings.  
21 As buildings get more and more efficient and they're  
22 small, there isn't much energy and costs to be saved.

23           The study also looked at PV, the relative -- you  
24 know, since the overall charter was how does a  
25 particular technology fit into the zero net energy

1 picture, where PV is kind of a benchmark. And at that  
2 time we were assuming a \$6.80 per watt cost for PV,  
3 which has come down considerably since then.

4 But even then, PV was more cost effective than  
5 GHP at that price point.

6 So, key barriers, kind of covered these. Again,  
7 the ratio of electric to gas in California is something  
8 that is a problem. Alternative rate structures that,  
9 you know, promote all-electric, efficient all-electric  
10 technologies like GHP can certainly improve that.

11 The low space conditioning loads, as we're  
12 looking forward, is going to be a challenge for your  
13 average-sized home, as space heating and cooling loads  
14 diminish due to other efficiency improvements.

15 And then, finally, the key driver on the -- or a  
16 key driver on the system costs are the high loop costs  
17 that we see in California for, you know, a variety of  
18 reasons. But, you know, those -- for the market to be  
19 successful, you know, those costs need to come down,  
20 increased volume clearly helps.

21 Alternative loop approaches to get ground loops  
22 in cheaper and, you know, community -- community-scale  
23 approaches where you can do a lot of infrastructure work  
24 early that will greatly reduce those costs and we'll all  
25 benefit from the technology and the overall economics.

1           And that is it.

2           MR. LOYER: And we'll be taking questions at the  
3 end of all of the presentations, so don't go any place,  
4 yet.

5           Next, Phil Henry is going to make a presentation  
6 of some of Dr. Xiaobing Liu's work, from the Oakridge  
7 National Laboratory.

8           And come up to the microphone.

9           MR. HENRY: So, Dr. Liu planned to attend and  
10 make this presentation. It would have been my  
11 preference if he was making it. He's the author and he  
12 would certainly have done a much better job than I'm  
13 about to do.

14           He, unfortunately, had some unexpected work  
15 project come up and so he just couldn't make it.

16           He did ask me to convey his interest in working  
17 with California's effort to bring GHPs into the mix,  
18 more so than what they are now.

19           I know there's been some outreach between the  
20 Energy Commission and Dr. Liu over the last several  
21 weeks, so I think there will be some good things to come  
22 in the future.

23           This -- let me just dig into it. We're going to  
24 go back out to the national level. You know, Paul --  
25 Paul had some kind of a national perspective a little

1 bit, a Colorado perspective. Marc was able to bring us  
2 back into some California-specific data.

3 And if we had the studies and the body of work  
4 to just present California data, that's all we'd be  
5 talking about today. Unfortunately, we don't.

6 There is some other work that's going on out  
7 there, that is making its way through the Energy  
8 Commission.

9 The California Geothermal Energy Collaborative  
10 did a study of kind of a California version of what  
11 Xiaobing has done, but not near as rigorous.

12 But it looked at the impact of installing GHPs  
13 across all 16 climate zones.

14 And like what Dr. Liu came up with from a  
15 national perspective, the results suggest that -- beg  
16 the question of why aren't we installing more?

17 And so, let's just move on here. I'm going to  
18 go right to -- right to -- there's been a lot of  
19 discussion today about, you know, what makes a ground  
20 source heat pump, and so rather than duplicate them,  
21 basically, just some key points.

22 The ground source heat pumps, geothermal heat  
23 pumps use renewable energy, they're highly efficiency,  
24 you can lessen the needle peaks, as Paul referred to,  
25 you can lessen the summer peak load and improve

1 utilities' load factor.

2           And if we were installing more systems, we could  
3 put more people to work right here in California, and  
4 doing work that can't be imported. It has to be done on  
5 site.

6           In terms of the -- in terms of the scope, there  
7 are -- you can read the slide with me, but there are 86  
8 million single-family homes, according to the 2008  
9 census. On average, 73 percent of the energy consumed  
10 in our built residential market is for space  
11 conditioning and water heating.

12           It is by far the lowest hanging fruit we have to  
13 work on.

14           In terms of what the -- what the market has  
15 done, if you look at this chart you'll see -- you'll see  
16 it has a nice -- a nice sloping curve in terms of the  
17 number of shipments nationally. It looks like we're  
18 getting great progress, things are going forward.

19           And then the recession starts kicking in and now  
20 we have this drop.

21           And I think as the -- with the Federal tax  
22 credits staying in place, the economy improves, and the  
23 interest in effective solutions, zinging these solutions  
24 I think you'll see this curve go back to sloping up  
25 quite nicely very quickly.

1           In terms of size of the market, less than one  
2 percent of the single-family homes have ground source  
3 heat pumps in them. It's going to be a number way less  
4 than one percent when you look at the actual number, I  
5 believe.

6           There are a number of reasons that the Oak Ridge  
7 wanted to take this on, that Xiaobing wanted to take  
8 this on, and it was a lot about public awareness. You  
9 know, you can deploy -- you can deploy geothermals, heat  
10 pumps and have significant savings in primary energy  
11 usage. It is a good solution for lowering your carbon  
12 footprint in a building.

13           And, once again, you can lower that summer peak  
14 which is a big issue, a huge issue for the utilities in  
15 California. It's a huge issue for us, as you know.

16           And then don't forget, the ratepayer, the  
17 consumer can yield some financial benefit.

18           Additionally, and this doesn't get talked a lot  
19 about very much is there's a pretty good pent-up demand  
20 in the investment community, looking for sound ways to  
21 invest in what you might call green technology, clean  
22 technology.

23           And what's missing from -- the missing piece, I  
24 believe, in terms of why the venture capital money, the  
25 big investment money is not moving aggressively into

1 this technology is we don't have a sufficient -- we're  
2 not giving them enough information. They like the  
3 technology, they want to get involved with it, but we  
4 can't successfully demonstrate the financial case in a  
5 big picture. And this is one of the things that  
6 Xiaobing wanted to begin to address from a national  
7 perspective.

8           And then the last item is to help the DOE moving  
9 further along the process of developing a roadmap for  
10 geothermal heat pumps, and that's been a very long-term  
11 project.

12           I'm going to skip a lot of the methodology.  
13 I'll point you to Xiaobing's study -- I'm sorry?

14           MR. LOYER: If I could just break in real quick.  
15 Xiaobing's study is available on our website, as well  
16 as, all the presentations that we're giving today, and a  
17 lot of other information, a lot of other studies that  
18 are centric around these issues. So, I just wanted to  
19 let everybody knew that they could get to this study  
20 very easily. So, sorry.

21           MR. HENRY: No, thank you. That's a good point.

22           Similar to what Davis Energy did with the work  
23 that Marc just spoke to, Xiaobing used what -- you know,  
24 kind of what's out there, what does the built  
25 environment exist of in terms of hot water, heating

1 systems, air conditioning systems, and heating systems  
2 from a national perspective.

3 So, we're actually -- we're speaking to what's  
4 installed in the homes around the country.

5 And these next three slides are pretty  
6 interesting. On the Y axis you'll see a scale in quad  
7 Btus. And then I don't know if you can make out the  
8 colors, but where Xiaobing's mapping electric heat pump  
9 usage, electric heater, natural gas furnace, propane,  
10 propane furnace and then fuel oil furnace.

11 And then those four vertical bars are looking at  
12 the country in four quadrants, Northeast, Midwest, South  
13 and West.

14 And it makes sense that you'd see some higher  
15 heating demands in the Midwest and lower out West. That  
16 makes sense.

17 And then you go to the cooling side and you'll  
18 see that in reverse. In the South and West,  
19 particularly the South is quite high.

20 And then what's really interesting is when you  
21 go to look at the energy consumption for water heating  
22 that's pretty -- that gets levelized no matter where you  
23 are in the country because the amount of hot water you  
24 need is not a function of how cold it is, unless you're  
25 using it for heating. But for domestic uses, you know,

1 you could be in New York, you can be in Hawaii, you can  
2 be in Maine and take the similar number of showers,  
3 similar number of dishes, similar number of occupants in  
4 the house, so it's quite level.

5 And the amount of energy used is quite large,  
6 depending on which data you look at.

7 So, it's an opportunity on a global perspective  
8 for getting some low-hanging fruit is what I would try  
9 to say, and it's -- we tend to get hung up on space  
10 heating, space conditioning, ventilation, that sort of  
11 stuff and oftentimes forget about domestic hot water  
12 production. I'm suggesting we shouldn't overlook it.

13 Xiaobing gets into describing a ground source  
14 heat pump system. We've had sufficient talk of that  
15 today. You won't see anything different on this slide  
16 than what was presented earlier by Lisa Meline and Dr.  
17 Kavanaugh.

18 Now, looking, this slide speaks to -- you know,  
19 at the lower right, the ground water temperatures across  
20 the U.S. It's fairly -- there's a relatively small  
21 range. When you look at the climate zones, you know,  
22 there's only a handful of them.

23 And then in the top left you have, as opposed to  
24 California 16. And then in the top left you have the  
25 U.S. Census regions and divisions.

1           The reason all three of these are here is Dr.  
2 Liu had to have data from all three of these sources to  
3 put this study together and this -- so, he's speaking to  
4 where they came from.

5           Let me skip through. You'll pardon me, I  
6 haven't had enough time with Xiaobing's -- this --  
7 Xiaobing, with this slide, what he's getting to here is  
8 the -- there's the trend in -- the trend of energy  
9 consumption nationally. It's not down. Even with  
10 increased existing energy efficiency measures it's still  
11 a trend upwards. Right, it's continuing to go upwards.  
12 And unless we do something different, it's going to  
13 continue to go upwards at a similar rate.

14           If this was -- Xiaobing did this in 2002 and so  
15 from 2002 to, roughly, 2030, if we don't do anything  
16 different we will add 2.2 quad Btu to our energy  
17 consumption, right.

18           If we deploy GHP systems in 100 percent of the  
19 single-family residences in this country, we will reduce  
20 the energy consumed in the same homes, from a national  
21 perspective, 4.2 quad Btu, which is a pretty large  
22 number, I think you would agree.

23           Now, I've said a hundred percent penetration  
24 rate. This slide speaks to various 20 percent --  
25 various penetration rates of the technology from 20 to

1 100, and then looks at energy savings, CO2 emission  
2 reduction, summer peak demand reduction, which is one of  
3 my favorite subjects, and then the dollars and cents  
4 piece, what's the ratepayer is saving.

5           And so, and you can look at the slide, yourself.  
6 But even at a 20-percent reduction, so going from the  
7 current one percent penetration to a 20 percent  
8 penetration we'll see nine percent -- we'll see nine  
9 percent of that 4.2 quad Btu, right.

10           In terms of CO2, we'll see approaching a 10  
11 percent reduction. And then another, better than 10  
12 percent on summer peak demand and the consumer will have  
13 10 percent -- will have a 10 percent savings on what  
14 they write the utility check for each month, which is  
15 also one of my favorite subjects.

16           And now with this -- now, if you want to see  
17 how -- we've talked about the national to California.  
18 We're going back to California, you know, how do we  
19 compare around the country. Let's take the big picture,  
20 how do we compare with the rest of the civilized world,  
21 right?

22           And so you'll see two -- we have two curves  
23 plotted here. One is looking at the penetration of the  
24 technology in the new housing segment, and then the one  
25 to the right is the penetration into the built

1 environment, either through retrofit or remodeling.

2           And you see a similar curve, and you see the  
3 same countries leading, Sweden, Switzerland, Finland,  
4 Austria. Certainly, Sweden is clearly the leader in  
5 terms of deployment.

6           And then I don't know if you can see it on the  
7 screen there, but there's two little red arrows down at  
8 the very bottom, almost at the X axis. In other words,  
9 just like barely above zero, that's where the USA is.

10           You know, it would be an interesting  
11 conversation to have about why that is.

12           So, bringing it back to California, last year we  
13 had the opportunity to work with Environment California  
14 on a fact sheet they were putting together for  
15 geothermal heat pumps, and they reached out to our group  
16 for some help.

17           We were interested in, basically, and Xiaobing  
18 and I have talked about this quite a bit is, you know,  
19 somehow California-izing his National Retrofit Study to  
20 California.

21           And so, we set about looking at some of the  
22 data. And so the question that we wanted to get at is  
23 what's the impact on the Governor's 12 gigawatt by 2020  
24 Executive Order of deploying geo, and maybe then how  
25 does it compare with solar PV. And the broader question

1 is what happens if we do both, sort of thing.

2           And so, the assumptions that Xiaobing made was a  
3 solar energy system output in a day is equivalent to  
4 five full load hours, five hours per day. I won't go  
5 through and list all of these but he's taken published  
6 data from the solar PV industry, right, as he's done  
7 this work. He's pulled in the pertinent parts of his  
8 Retrofit Study, right. And then he has equated the  
9 savings component from GHPs as the renewable component,  
10 pulled that back into the comparison, which that's where  
11 the savings comes from is what's going on in the ground.

12           And he cut to the chase. If we -- of the 13  
13 million single-family residences in California, if we  
14 put geothermal heat pumps in 23 percent of them, we  
15 would have -- oops, I thought this was on this slide.

16           Oh, yeah, we would be at -- thank you, yeah, I  
17 just missed my punch line. I'm still thinking about all  
18 the cuisine metaphors in Paul's thing, I'm starting to  
19 get hungry again, actually.

20           We would be at the Governor's EO, 23 percent of  
21 the homes. You know, that's pretty impressive. Is that  
22 attainable? We can discuss that. But the conclusion is  
23 geothermal heat pumps can play a role in realizing that  
24 specific Executive Order.

25           How am I doing on time over there? I'm doing

1 good on time, okay.

2           Putting some numbers and going back to, you  
3 know, some key points, the ground source heat pumps  
4 reduce the peak demand, and in this study Xiaobing  
5 reports, 2.1 KW per unit. Right, that's a significant  
6 number.

7           The consumer's bill for space heating reduced by  
8 48 percent and this is on a national perspective.

9           And in terms of reducing -- in terms of reducing  
10 a carbon footprint in California, in terms of meeting AB  
11 32 objectives, 44 percent reduction. You know, pretty  
12 significant numbers, I would believe.

13           But we're not going to get there unless we  
14 deploy these systems. And so, Xiaobing puts forth some  
15 action items to do. The third-party owned, geothermal  
16 plant, he's talking about loop financing models. How do  
17 you get the most -- first, how do you get the  
18 incremental costs dealt with so the consumer, the  
19 project owner, the building owners can get the benefits  
20 without having to write a big check. Paul's going to  
21 dig into that very aggressively in a few minutes.

22           The other area is in terms of regulation and in  
23 terms of incentives, you know, does our -- do appraisals  
24 on real estate accurately reflect the impact of having a  
25 geothermal heat pump system in it? Mostly not, in some

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1 cases more than others.

2           And how do we ensure that what's going in the  
3 ground, what's going in the -- into the building, the  
4 quality of the system is meeting some minimum  
5 thresholds, and that's what Lisa and Dr. Kavanaugh spent  
6 the morning talking about.

7           And then we get into -- then we get into some  
8 parts and pieces to make the technology happen.  
9 Engineers, designers, they need some tools. There's  
10 some great design tools, but there's some insufficient  
11 hard data verifying that the designs that -- the design  
12 methodologies are actually being played out in the  
13 field, right, and that's a missing piece.

14           We could use some more work in terms of are  
15 there any -- are there ways that we can lessen the cost  
16 to go put that loop in the ground, are there other  
17 approaches. We know what definitely works, but there's  
18 probably some things we can do moving forward, where we  
19 could get some more efficiencies, maybe lower some  
20 costs.

21           And then one of my favorite subjects is the  
22 smart operations. You know, I started in this industry  
23 a few blocks away from here, in high school, doing  
24 system balance, all right, and we were all about making  
25 sure, as you know -- the engineers in here, making sure

1 that what was on the piece of paper that got built was  
2 actually working the way the engineer intended. Right,  
3 and it's the idea of commissioning, and the post-retro-  
4 commissioning. You know, that's smart operation.

5 And so, essentially, as you might guess, Dr. Liu  
6 concludes that, and I'll paraphrase in a big way, it  
7 would be in everyone's best interest if we deployed more  
8 geothermal heat pumps.

9 And although Xiaobing isn't -- Dr. Liu isn't  
10 here, he is interested in taking questions. For those  
11 of you who are attending remotely, he will respond to  
12 his e-mail. He's very busy, but he is interested in  
13 speaking to this subject matter. And so with that, I  
14 think I am done. Thank you.

15 MR. LOYER: Thanks Phil, appreciate it.

16 MR. HENRY: Thank Xiaobing.

17 MR. LOYER: And thank you, Dr. Liu.

18 And now, we're going to invite Paul back up and  
19 sort of finish this session off, and we have plenty of  
20 time, Paul, so stretch it out.

21 MR. BONY: It's nice to follow Phil and have  
22 time.

23 All right, how do we get back to where we were?  
24 It should be right -- where's the pointer?

25 Actually, I want to go to one slide here. I was

1 going to give you a copy of that, too.

2           It's a good thing we have time for all this  
3 technology. I'll do this real quick.

4           Before I get into, you know, post-intermission  
5 here, one thing that I really didn't have a chance to  
6 drive home, this is pretty much what California does.  
7 The utility peaks, and we've talked a little bit about  
8 that, the utility does not peak at noon. A lot of  
9 people think that's the perception. It really peaks  
10 later in the evening.

11           This happens to be the Louisville, Kentucky. I  
12 have this slide because there were four utilities that I  
13 did a workshop for that all came together there on the  
14 river. Their peaks are somewhere between 6:00, and  
15 7:00, 8:00 at night.

16           The chart on the right kind of shows that,  
17 really, roof-mounted PV isn't doing anything at 6:00,  
18 7:00, 8:00 at night, so if you think PVs are going to  
19 eliminate utility peaks, they're going to carve out  
20 kilowatt hours when the sun shining, but they're not  
21 going to dig that peak down.

22           And then if you have SEER-rated equipment, and  
23 I'll go into that in a little bit more detail here in a  
24 second, if you're basing your savings on high SEER  
25 equipment that's really not working when it's 100

1 degrees at 6:00, 7:00 at night, you've really just made  
2 the electric system worse off. You've built all the  
3 plant to maximum capacity at a point in time where high-  
4 SEER equipment and PV aren't doing anything for the  
5 peaks. I just didn't want to let that go by. That was  
6 a refresher real quick there for some of you.

7           The other thing, too, and this is a paper that  
8 just came out, years ago, a little bit of a history  
9 lesson, I really got into ground source heat pump. And  
10 there are a couple of things that we did here, in  
11 California, that were leader -- you know, industry-  
12 leading 20 years ago.

13           Once upon a time there was a ground source heat  
14 pump consortium, which was funded by the Department of  
15 Energy, and California received two of the like first 12  
16 or 14 grants for ground source heat pumps. And I'll  
17 talk about what a lot of utilities across the country  
18 are doing with the programs that were developed in  
19 California for ground source heat pumps.

20           But the lady who was on staff then was Catherine  
21 Johnson, who's now Dr. Johnson, and she just released a  
22 paper called "Geothermal Heat Pumps, the Killer AP for  
23 the -- the Utility Killer AP for the 21st Century."

24           So, Joe, I'm going to give this to you. I could  
25 sign it because, you know, I'm right here in person and

1 stuff.

2 (Laughter)

3 MR. BONY: And I brought a couple others.

4 But, basically, it's a good segue into this. I  
5 was asked to speak because I was a utility guy and I got  
6 into ground source heat pumps as a utility demand-side  
7 planner, when my mission was what can we do to meet  
8 these regulatory requirements to have energy efficiency.  
9 And it was really before renewable energy came on board.

10 And my boss said, whatever you do, don't raise  
11 rates. And so, that was kind of an intimidating  
12 challenge.

13 And so, really, the only two technologies that  
14 came out to work were lighting, and this was back  
15 before, you know, we had Federal laws that eliminated  
16 the Edison bulb.

17 But, basically, lighting that was on, on-peak,  
18 was a good opportunity because we could retrofit that  
19 on-peak lighting with CFLs at the time, and ground  
20 source heat pumps.

21 So, what I'm going to talk about today on this  
22 utility perspective really has been around for a long  
23 time, but the arguments have actually gotten better for  
24 geothermal.

25 And I am convinced, and it actually started here

1 in California, the ground loop really, really looks like  
2 a utility plant. It has a long lifecycle. You heard  
3 earlier from Lisa that it's, you know, 50-year, 55-year  
4 warranties. I've got -- if we ever had more time, I can  
5 show you pictures of houses that have burned down and  
6 been wiped out by hurricanes and tornadoes and the only  
7 thing left is the ground loop, right. So, you build  
8 your house back and your ground loop's there.

9           A little bit of New York, they're actually --  
10 they lost a lot of oil tanks when they had Hurricane  
11 Sandy come through. And they're saying, wait a minute,  
12 why are we going to put these oil tanks back in the  
13 beach that just washed out? Why don't we put in ground  
14 loops because they're going to be there and they're  
15 going to be weather proof.

16           So, ground source heat pump loops look, feel and  
17 act like long-term utility plant. And the problem with  
18 ground source heat pumps, as you've heard over and over  
19 again, is first cost.

20           It's kind of like if you bought a cell phone and  
21 the cell service company, you know, you picked said, oh,  
22 I tell you what, we want you to pay for the towers and  
23 all the infrastructure so you can use your cell phone up  
24 front, and then the minutes will be free.

25           No, they charge us by the minute and then the

1 minutes come down with competition.

2           So, if we took a utility perspective that said  
3 who can invest in these loops over 25-, 35-, 45-year  
4 time horizons what would the first cost be for ground  
5 source heat pumps? And I would say the first cost  
6 barrier would then go away, and we'll talk a little bit  
7 about that this afternoon.

8           So, you know, and I've got this sense of humor  
9 thing, so why should utilities support ground source  
10 heat pumps? Well, somebody's got to row the boat,  
11 right. In our case we've got our consumers in the  
12 front, doing all the work, and the utility that gets all  
13 the benefits kind of sitting in the back of the boat,  
14 smoking a cigarette, and going along for the ride.  
15 We've got it totally backwards here.

16           But utilities can bring a lot of value to the  
17 table for ground source heat pumps. First of all,  
18 they're in the energy business, right, that's all they  
19 do.

20           They've got the patience. How long has PG&E or  
21 SMUD been around? I think, the last time I looked, a  
22 little over 100 years, so they've got a little track  
23 record there.

24           They have access to capital. There's economic  
25 incentives and we'll talk about that, where ground

1 source heat pumps actually lower rates and have economic  
2 incentives for the utility because of their impacts on  
3 the grid.

4           Everybody gets a bill from their utility, right,  
5 so there's a way to message and there's a way to recover  
6 your costs.

7           And they've been doing these energy efficiency  
8 and renewable energy programs for 20 plus years. So,  
9 there's a natural fit between geothermal and utilities.

10           So, there's some good news and there's some bad  
11 news. So, the Federal Database attracts utility  
12 programs. When I put in ground source heat pumps I  
13 picked up 345 utilities that had some form of ground  
14 source heat pump incent.

15           Unfortunately, most of those are small rebates.  
16 If you're a consumer, a residential consumer, I  
17 guarantee you a \$250 rebate is probably not going to  
18 make your purchase decision on a \$30,000 ground source  
19 heat pump retrofit.

20           But if you want to have a -- in the old days I  
21 had a boss who said, basically -- I figured out early on  
22 if I had a brochure and a rebate I had a program, right.  
23 So, we need to kind of go beyond brochures and token  
24 rebates if we're going to make an impact.

25           So, there are really, probably, less than 50

1 active utility programs out there. And when I say  
2 active, there's an ongoing effort, there's somebody in  
3 the utility who's championed with promoting ground  
4 source heat pumps and it's part of what they want to  
5 accomplish.

6           The good news is that the few utilities, and  
7 I'll go through some examples with you this afternoon,  
8 that do have programs, and do have the vision, and do  
9 see why ground source heat pumps fit into the utility  
10 model are doing really well.

11           So, it goes back to, you know, why do we  
12 regulate utilities and why do we drag utilities into  
13 this energy efficiency and renewable energy business.  
14 Well, it's because we're trying -- right now we're  
15 trying to reduce greenhouse gas emissions and utilities  
16 are a real nice target to do that because a lot of  
17 greenhouse gas emissions come from gas, natural gas  
18 companies, and electric companies.

19           I think our focus as a society's been off a  
20 little bit, though, because especially for the electric  
21 companies it's been based on we're going to reduce  
22 kilowatt hour consumption because that, 15 years ago,  
23 was probably the easiest way to get to carbon.

24           However, when we get to an 80, 90 percent  
25 carbon-free kilowatt hour stream is that really where

1 we're going to go for future carbon savings or do we  
2 really need to change the look to Btus, because carbon  
3 lives in system Btus.

4           And, you know, I remember a little bit of high  
5 school chemistry. The chemical equation for natural gas  
6 is CH<sub>4</sub>, right. And when you oxidize it that means you  
7 burn it, you put some O<sub>2</sub> in it and now you get CO<sub>2</sub>,  
8 unless you've got bad burner conditions and then you get  
9 CO, and you either get a headache and flu-like symptoms,  
10 or you wake up dead, so those are kind of your options.

11           But there's a lot of carbon in burning fossil  
12 fuels. And as we take carbon out of electricity, and I  
13 said this earlier today, now we can take carbon out of  
14 heating, cooling, and water heating because we're going  
15 to have low-carbon electricity, or on-site zero carbon  
16 electricity, and a compressor, and the renewable energy  
17 in the ground, and that's how we get the big chunk of  
18 carbon that we're not addressing out of the system.

19           And the utilities are a good way to do that.

20           So, we have this public interest theory, which  
21 basically said utilities are regulated monopolies, and  
22 it was more cost effective to have one regulated utility  
23 than a bunch of competing utilities.

24           That model's kind of breaking down when  
25 everybody can have distributed generation on their

1 rooftop, right.

2           So, what's the role in the utility world where  
3 the whole regulatory framework is kind of being  
4 disrupted by distributed generation?

5           However, we still have this public interest in  
6 climate change, right. So, what are we going to do as  
7 part of the public interest to address climate change?

8           And utilities are still a focus target. There's  
9 not a whole lot of them, they're pretty easy to have  
10 oversight with. And so if we went after efficiency  
11 programs in the past, where we targeted lighting, we  
12 targeted appliances, we've targeted building shells, and  
13 we have had allowances and all kinds of formulas to  
14 incent utilities to sell less of their program, and the  
15 mechanism to pay for all of that was rates.

16           Now, having done utility program design, one of  
17 the -- I know for a fact one of the big balancing points  
18 is how much pressure do you put on rates to achieve  
19 those social objectives.

20           Well, what if you could get those social  
21 objectives, in this case carbon reduction and reducing  
22 consumers' total energy bills and not put pressure on  
23 rates; would that not be a win/win for the regulators,  
24 the consumers and the utilities.

25           Well, ground source heat pumps I think can get

1 you there. And that's why 20 some years ago, as a  
2 utility guy, I gravitated towards ground source heat  
3 pumps as a DSM program because it, again, was one of  
4 those programs that the benefits to the consumer and the  
5 benefits to the utility, basically everybody won.

6           The only person who didn't win was whoever was  
7 selling the fossil fuel that we're replacing. And I  
8 guarantee if you're in the foothills buying propane and  
9 somewhere between \$2.00 and \$4.00 a gallon nobody's  
10 looking out for you in this regulatory arena right now  
11 if you're a propane customer with high thermal loads in  
12 the Sierras. And this is an opportunity to even address  
13 that market niche that hasn't been served.

14           And if we treat the loops like a utility plant,  
15 and I'll show you some examples of that, the utility now  
16 has the opportunity to invest in a renewable resource  
17 that they can get their authorized rate of return on,  
18 that improves their load factor and that takes pressure  
19 off of rates.

20           And the Feds just came out with a study that  
21 said the expected growth in residential kilowatt hour  
22 sales over the next 20 years is going to be less than  
23 one percent, less than one percent over the next 20  
24 years.

25           And when I talk to utilities across the country,

1 the single biggest pressure point they have right now is  
2 budget cuts driven by lack of increasing sales in  
3 kilowatt hours, right.

4           So, in the old days it was kind of a -- I don't  
5 know if you'd call it a joke, but the story was don't  
6 worry about the budget too much because when you have  
7 two, three, four percent annual growth in kilowatt hour  
8 sales your budgets are going to be okay just because of  
9 organic growth.

10           Well, the utilities are now hitting where  
11 because of lighting efficiency, appliance efficiency,  
12 energy efficiency, on-site generation they can't -- they  
13 can't rely on increased growth in kilowatt hour sales to  
14 drive their budget process.

15           However, ground source heat pumps can shore up  
16 their load factor so the growth doesn't have to come  
17 from new customers, it can come from that valley filling  
18 that I talked to you about earlier, also offset by the  
19 peak clipping. And when your load factor goes up and  
20 you have a more-revenue-per-dollar-invested plant that,  
21 by definition, keeps pressure off consumer rates.

22           So, this is a really nice report. I don't know  
23 if you guys have it on your website or not, Joe. But it  
24 was basically this -- do you have that one? You will,  
25 okay.

1           It was basically a study of this morphing that's  
2 going on in the utility industry. Sometimes, when I  
3 give this part of the presentation I call it "this is  
4 not your father's utility anymore" because the rules  
5 have changed that much.

6           So, we've really been working for the last 20  
7 some years with demand side programs, and renewable  
8 energy portfolio standards and stuff to make some  
9 fundamental changes to the utility industry from a  
10 regulatory stand point.

11           And technology is starting to make fundamental  
12 changes. I mean, when you can install a rooftop PV for  
13 \$3.00 a watt, and the panels are at 80 cents, now, when  
14 I first was looking at PV it was \$10.00 a watt just for  
15 the panel. There's a lot going on that's changing the  
16 regulatory paradigm and the utility paradigm, and it's  
17 all kind of coming to a head, driven by California's  
18 leadership.

19           What is the utility's role in a world where all  
20 new buildings cannot -- have to be net zero by  
21 definition, gas or electric?

22           What's your role as a utility company in a net  
23 zero environment, right? What's your growth potential  
24 when at a point in time all new buildings won't need  
25 you, other than as a big battery for kilowatt hours,

1 right.

2           So, this report basically says successful  
3 utilities are going to have to start thinking about how  
4 to position themselves for this new, low-carbon,  
5 distributed generation environment.

6           And that the modern utility's going to have to,  
7 if they want to continue as a business entity, they're  
8 going to have to come up with solutions to cope with  
9 climate change and the desire of customers to take a  
10 more proactive role in their energy choices.

11           That's really polite language for saying to tell  
12 the utility company to take a hike, right, I want to be  
13 independent, I want to be grid independent. I want to  
14 be responsible for my own energy use.

15           However, new approaches, and this is how this  
16 report kind of closes out, new approaches to serving  
17 customers with less energy at the same -- will basically  
18 let the utility kind of move into a new field. And I  
19 can't find anything other than owning that renewable,  
20 some piece of that renewable or distributed generation  
21 investment that would let utilities transition.

22           And what did I start out with, those ground  
23 source heat pump loops look like a utility plant, so I  
24 think it's a really nice segue for a utility to stay in  
25 the utility model, make long-term investments, make

1 long-term payment streams with their customers, and  
2 deliver low-carbon, high-efficiency energy services.

3           So, ground source heat pumps do everything that  
4 utilities are looking for. They clip peaks, and we've  
5 heard that a couple of times, now. And I'll show you  
6 some numbers from real utility studies.

7           They improve load factor, they fill the valleys,  
8 they generate huge carbon reduction emissions, and I'll  
9 walk you through some math on that. They basically give  
10 you a chance to interact with your customer for a  
11 monthly payment or a monthly transaction that goes  
12 through your billing process. They can do all of that  
13 without putting pressure on electric rates.

14           And in fact, and I've done it over several  
15 times, the utilities actually can help make rates go  
16 down, so who's -- I don't know anybody who's against  
17 that.

18           And sort of the additional benefits is, you  
19 know, you're providing a new service. If a utility  
20 knocked on your door, as a consumer, and said, we want  
21 to lower your total monthly or annual bills by a  
22 thousand dollars a year, we're here to help. Sign here,  
23 we're going to keep you as comfortable as you are now,  
24 we're going to cut your carbon footprint by 50 to 60  
25 percent, and you're going to have a thousand dollars a

1 year left over would that shock you? Would that make  
2 you like your utility company a little bit more than  
3 reading in the paper, oh, rates are going up another  
4 nine percent this year, or whatever?

5           What if a utility, and I used to have to do  
6 this, went to a hearing at the Public Utility Commission  
7 and the interveners were all there saying what a great  
8 guy you were. What are the odds of that, right? I  
9 mean, usually, somebody's picking on the utility rate  
10 case.

11           Well, ground source heat pumps can drive  
12 environmental goals and they can provide economic  
13 development. Phil kind of hit on it, we're not going to  
14 import boreholes and loops from overseas. We have to  
15 put them in with local labor right here and, you know,  
16 we're just not going to bring them in by the container  
17 ship in Oakland and roll them out, because you just  
18 can't do that with a borehole.

19           Utility economics, lost revenue, and the other  
20 thing that -- when the utilities don't get to buy power  
21 plants, what do they get their return on investment on?  
22 Remodeling the offices, right? So, loops give the  
23 utilities an opportunity to put capital in the ground,  
24 get their authorized rate of return on that capital and  
25 still grow their business.

1           And so, the National Rural Electric Cooperative  
2 Association, the American Public Power Association, the  
3 Edison Electric Institute have all said ground source  
4 heat pumps and the efficiency they provide are a no-  
5 regret strategy for utilities, so that's a pretty cool  
6 thing.

7           So, again, we've kind of seen this, you take the  
8 peaks off and you shove them into the valleys, and that  
9 helps utility economics.

10           So, let's walk through a couple of case studies  
11 of some folks I get to work with across the country.  
12 I've started out in Oklahoma. We are Oklahoma-based at  
13 ClimateMaster.

14           This was a joint effort. This was when the  
15 first Stimulus Grants came out. We worked with the  
16 Geothermal Resources Council and we got a grant for the  
17 Oklahoma Municipal Power Association. They're actually  
18 a division of state government, but they operate by a  
19 G&T, or a generation and transmission company for I  
20 think it's 13 cities in Oklahoma. So, think, they're  
21 the power supplier and transmission company for  
22 municipals, the biggest being the City of Edmond, in  
23 Oklahoma.

24           And they launched what they called the "Oklahoma  
25 Comfort Program." So, this was their dilemma. The OMPA

1 is the red line. All but one of their top four cities,  
2 which are about 80 percent of their total load, were  
3 seeing a steady decline in load factor.

4 So, the utility was paying more for peak power  
5 and having less kilowatt over the course of the year,  
6 which was only putting pressure on rates.

7 So, the worse rate increase is one where you  
8 have to ask for more money and you don't get anything  
9 for it, you're just covering costs that have escalated  
10 on you.

11 So, they wanted to improve load factor and the  
12 only way to improve load factor is to cut your peaks and  
13 fill your valleys.

14 So, they did a kind of a paper study. Some of  
15 it was based on some of the work by Oak Ridge. And they  
16 came to the conclusion that they could save 500 watts or  
17 a half a KW per ton of ground source heat pumps.

18 Okay, so that kind of fits in Dr. Liu's number.  
19 And that's the peak shavings that didn't include the  
20 valley filling that they were going to get.

21 So, they decided to do this ground source heat  
22 pump program to improve load factor by cutting peaks,  
23 they figured 500 watts a ton, and fill in their winter  
24 valleys because they have excess generation in the  
25 winter.

1           So, they came up with a -- they got \$3 million  
2 in Federal Stimulus money. They were already offering  
3 an \$800-a-ton ground source heat pump rebate, and they  
4 added \$1,000-a-ton to that with the Federal money.

5           The program started a year later than they  
6 wanted to. Oklahoma really had its act together when  
7 the Stimulus money came out. The notice of the Stimulus  
8 came out, in 90 days Oklahoma had their notices out, 60  
9 days later they had their awards out, a year later the  
10 Feds signed the contract with the State Energy Office to  
11 run their program.

12           So, we basically had two years to run a three-  
13 year program. They still used up almost all of the  
14 money that they were allocated for this program.

15           So, they were very happy that they got the load.  
16 Most of it, I was really surprised, it went about 50/50  
17 to residential customers and commercial customers.

18           So, now, they've got more -- they've got a few  
19 thousand installations under their belt. So, what  
20 they've decided was rebates really weren't the ticket.

21           The data doesn't show it clearly, but they're  
22 convinced that the cost per ton of the ground source  
23 heat pumps went up mostly driven by things like better  
24 equipment going in than maybe contractor grade stuff.  
25 They can't say that contractors profiteered, but they're

1 convinced that the rebates, a lot of the rebates were  
2 consumed by increased channel costs. They really can't  
3 zero it in and say, ah-ha, this is the case.

4           But what they realized is that \$1,800-a-ton in  
5 rebates they could have given away residential loops,  
6 right. So, that would have been enough in Oklahoma,  
7 loops are about six bucks a foot. They could have given  
8 the loops away.

9           That kind of planted this seed in their mind,  
10 well, if we take the first cost of the loop offline and  
11 we recover our money over the next 30 years, what's it  
12 costing us to get the loop in? Nothing.

13           So, we can get all of these utility load factor  
14 improvements and we can get our money back over time,  
15 and it really isn't a program cost, it's a program  
16 investment. And most of the smart utilities get that.  
17 You don't need to give something away, you just have to  
18 make it -- you have to have that easy button for the  
19 customer to mash, so it's an easy transaction to go  
20 ground source heat pumps.

21           So, and I put this week, because they haven't  
22 quite announced it, yet. They actually want to go  
23 back -- now, I've told you they serve cities in  
24 Oklahoma. They basically want to take their own city's  
25 infrastructure and retrofit -- the member cities'

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1 infrastructure to ground source heat pumps. Why? That  
2 levers tax dollars because it costs operating costs for  
3 municipal facilities.

4           So, they're looking at offering seven-year  
5 loans. They're probably going to bump that to 15 years,  
6 at about a one percent interest, and they're going to  
7 target their member cities, city halls, recreational  
8 centers, jails, all the firehouses, libraries, and all  
9 that kind of stuff, first. So, basically, for them it's  
10 the gift that keeps on giving. The city's operating  
11 costs go down, they basically can lever their bonding  
12 authority, and there's some third-party folks that think  
13 they can bring some zero interest money to the table,  
14 that kind of stuff.

15           And then once they get that kind of  
16 institutional thing going and they get those -- we heard  
17 earlier today how important it is to have good  
18 designers, it kind of develops a little bit of maturity  
19 for the installation environment, a little bit of  
20 maturity on the design environment and then they can  
21 roll that back out into their regular consumer market.  
22 So, I think that's a really, really wise strategy on  
23 their part.

24           So, I'll stay with the Oklahoma theme. Even  
25 though I'm from -- I live in Colorado, I think I've gone

1 back to my native Oklahoma because I've spent about  
2 three years working on these programs.

3 I am now ready to swim upstream to my mother's  
4 native California to help you all, so do take me away  
5 from the Red Plains of Oklahoma, please.

6 But, basically, Western Farmers is what you call  
7 a G&T, a generation and transmission co-op. So, they  
8 make electricity and they deliver it to 20 some co-ops  
9 across Oklahoma, mostly the western two-thirds of the  
10 state.

11 So, about three years ago they wanted to  
12 increase exposure to ground source heat pumps to two  
13 markets. Their consumers, the people who pay bills to  
14 the member co-ops, and to the co-ops, themselves,  
15 because the G&T understood the value of ground source  
16 heat pumps, but they don't think their member utilities  
17 did.

18 So, we started out with a sweepstakes. So, for  
19 those of you, anybody here who's a utility person and  
20 you want to do -- you want to learn lessons, don't do a  
21 sweepstakes. The odds of winning a \$30,000 heat pump  
22 are not enough to get you to buy a \$30,000 ground source  
23 heat pump, okay. And there's all kinds of rules with  
24 sweepstakes.

25 But that's okay, it got their toe in the water,

1 it gave them a year to talk to their members about  
2 ground source heat pumps.

3           So, now, and this is one of the -- I think this  
4 is the coolest ground source heat pump program going and  
5 I'll share a little bit more detail with you in a  
6 minute.

7           Even as we speak, and I think tomorrow or  
8 Friday -- yeah, tomorrow is Friday, it's the last day,  
9 they're having a "Go-Go GEO Challenge" for all juniors  
10 and seniors in any -- any high school junior or senior  
11 in the State of Oklahoma. They posted their videos.  
12 I'll share the website with you. Today and tomorrow are  
13 the last days to vote. And they decided to use social  
14 media, you know, mom, dad, and grandpa, and the  
15 creativity of Oklahoma -- of America's youth to drive  
16 public awareness of ground source heat pumps, right, in  
17 these rural communities.

18           And then the utilities will come in with their  
19 programs that I'll talk about here in a minute, okay.

20           The other thing that's interesting about that  
21 program and, again, a great model for California, it was  
22 the first time, and I've been doing ground source heat  
23 pumps as a utility guy, and now as a manufacturer, for  
24 over 20 years, all three major manufacturers were  
25 partnered in that program, and we're all in the room

1 here today, plus some, right. So, it's never been done  
2 before, very cool.

3 So, it's kind of like, you know, a rising tide  
4 floats all boat strategy.

5 That has led to -- they have about, I think the  
6 last count was seven utilities are getting ready to  
7 adopt a California idea, okay.

8 Plumas Sierra Rural Electric, here in  
9 California, up in the mountains, was the first utility  
10 in the country to offer ground source heat pump loops  
11 for a fixed monthly fee.

12 Last time I looked it was still the only utility  
13 company in California to offer ground source heat pump  
14 loops for a fixed monthly fee. And that program has  
15 been in place for about 15 years.

16 And when I go talk to our contractors that serve  
17 that area, they love it. Right, because the loops  
18 there, they don't have to sell the loop, the quality  
19 control's already in place. And they said -- and when I  
20 asked contractors what can we do to grow the market in  
21 Nevada or California, they say if we could just have  
22 more programs like that one they have at Plumas Sierra.

23 Now, as a utility person when was the last time  
24 contractors raved about your program? Right, I mean,  
25 isn't that your biggest fear is you're going to do

1 something to aggravate the contractor community? You're  
2 going to make them mad by telling them what to do. What  
3 if they were saying do more of this; would you want to  
4 put your budgets there?

5 So, that was a California idea and now there's  
6 probably going to be seven, eight utilities in Oklahoma  
7 that will be doing that by year end.

8 So, and the nice thing about the utility  
9 programs where they take the first cost off the table is  
10 it can come in different flavors. It can come in loop  
11 leasing, which is what Plumas Sierra does. It can come  
12 in loop financing. It can come in whole system  
13 financing. And I'll talk a little bit about on-bill  
14 financing and on-bill collection. It can come from  
15 partnering with third-party people.

16 And I have four of these, this whole paper that  
17 Dr. Johnson did is about how utilities can form  
18 partnerships. So, you may not want to be the bank, you  
19 may not want to be the implementer, but you can still  
20 form the partnerships where all that comes together in a  
21 model where everybody wins, including the contractor  
22 community.

23 So, and this, in leveraging this co-op financing,  
24 the Feds, through the Rural Utility Service, in the  
25 next, you know, it will probably be about 90 to 120

1 days, the Rural Utility Service is going to offer their  
2 standard loans, that would normally go to poles, wires,  
3 transmission lines for efficiency measures, and it  
4 specifically mentions ground source heat pumps as an  
5 enabled technology.

6           Okay, now, that's what I'll talk a little bit  
7 about in a minute.

8           But, basically, the equipment, the loop, the  
9 utility can basically borrow the money from the Feds,  
10 write a business plan. They can input that money into a  
11 third-party partnership. They can invest that money,  
12 themselves. But, basically, the Feds are all in on the  
13 rural utility side for promoting ground source heat  
14 pumps.

15           And I haven't seen the final language, yet, the  
16 draft that they're basically negotiating, is through the  
17 RUS and the Office of -- the OMB, Office of Management  
18 and Budget. The last draft I saw basically said they  
19 could make those funds available to all flavors of  
20 utilities, so IOUs and Municipals.

21           And that money right now, last time I looked,  
22 30-year funds were under three percent to do that, okay.

23           And then the "kahuna" of them all, several of  
24 those companies, the utilities are looking at loop  
25 tariffs where, basically, they own it, it's a flat

1 monthly fee.

2           There's one co-op, if you're interested in their  
3 program, it's Caddo Electric, C-a-d-d-o, a small,  
4 16,000-meter co-op in Oklahoma, about the same size as  
5 Plumas Sierra. They actually are going to take that  
6 loop investment and put it in their general rate base  
7 because the theory is all the members benefit from the  
8 peak demand clipping, right. They're going to collect  
9 the fee out of their general rate base so they figure  
10 they'll have all their money back from their general  
11 rates in about five years.

12           And what is the expiration date of a loop  
13 tariff? Yeah, it's like the old street lights we used  
14 to put up, or alley lights, right. We put the alley  
15 light up and if you paid me for 45 years for an alley  
16 light, we did okay.

17           So, how much does a ground source heat pump peak  
18 clipping program cost when the consumer pays for the  
19 whole cost of the loop in five years, and the revenue  
20 stream keeps coming, right? So, does that revenue  
21 stream put pressure on rates or take pressure off of  
22 rates? It takes pressure off of rates, right.

23           Does the customer mind paying \$14.00 a month for  
24 a loop that otherwise would have cost, I don't know,  
25 \$9,000? No.

1

2           And at that low monthly charge the incremental  
3 cost between a ground source heat pump and a high-  
4 efficiency air conditioner, with that SEER rating that  
5 kills the utility, and a high-efficiency gas furnace is  
6 even, before the Federal tax credits, which we really  
7 haven't talked about, which are 30 percent -- as soon as  
8 they announced that thermal tariff, this Caddo Electric,  
9 they got a 250-home subdivision. Now, did I tell you  
10 they had 16,000 meters to start with? So, they got the  
11 biggest home builder in Oklahoma to open their next  
12 subdivision on that electric co-op's lines because of  
13 that thermal tariff.

14           So, that's the power of the utilities being able  
15 to own the loops.

16           The other thing that these utilities are doing  
17 is they're bringing in -- and we haven't talked too much  
18 about this today, they're bringing ground source heat  
19 pumps into their key account efforts. So, key accounts  
20 are the bigger customers, with the bigger bills. We  
21 haven't seen any examples and, hopefully, we can talk  
22 about it at the workshop next month.

23           With the tax credits that are available for  
24 ground source heat pumps, which include a Federal tax  
25 credit at 10 percent, 50 percent bonused depreciation in

1 the first year, five-year accelerated depreciation, up  
2 to \$1.50 a square foot tax deduction for an efficient  
3 building we're seeing commercial projects go ground  
4 source heat pump with paybacks of under two years, okay.

5           Now, if the utility were to finance the loop  
6 what's the -- how fast is the payback then? Well, it's  
7 instant, right, because the loop can be as much as 30  
8 percent of the cost. And there's even bigger demand  
9 savings and valley filling opportunities in the  
10 commercial buildings than there are in the residential  
11 space.

12           A quick example, Western Farmers also serves  
13 four co-ops on the fringe of Eastern New Mexico, on the  
14 Texas border. They looked at the dairy industry. The  
15 dairy farmers, who take -- basically, they take hot milk  
16 out of cows, right, and they chill it and they throw  
17 that energy into the air, which is kind of hard to do in  
18 New Mexico in the summertime. Then they take gallons  
19 and gallons of propane and they burn that to make hot  
20 water, so they can wash the cow, so they can take the  
21 milk out of them.

22           Ground source heat pumps take the hot milk out  
23 of the cow, chill it, and dump it into the water so  
24 you're basically using the heat in the milk to wash the  
25 cow; less than two-year paybacks for the dairy industry,

1 in New Mexico, if they convert to ground source heat  
2 pumps.

3 Now, I drove up from Southern California today  
4 and I drove by a whole bunch of happy California cows  
5 that I think could benefit from ground source heat pumps  
6 if Edison and PG&E wanted to go after that niche market.

7 Okay, so in just those four co-ops in New Mexico  
8 they identified 60 megawatts of demand reduction in  
9 about a half-a-dozen dairies.

10 And then those dairies support -- I didn't know  
11 this. Did you know the largest cheddar cheese factory  
12 in the United States is in New Mexico? There you go.  
13 So, now, they're looking at the demand savings at the  
14 cheddar cheese factory which, by the way, has to have  
15 hot and cold in the same factory, okay.

16 So, they're basically training their staff, now,  
17 to go after these ground source heat pump retrofit  
18 opportunities using a design build model. So,  
19 basically, they cover the design build costs of the  
20 projects. What does that give them? Control over the  
21 design.

22 And then there's that subdivision I talked about  
23 that the First Thermal Service got.

24 Here's the "Go-Go Geo Challenge," I just kind of  
25 snuck this in there. So, yeah, you have until midnight

1 today to vote, so as soon as you run home. Some of  
2 these videos are ready for like prime time television  
3 commercials, some are not. So, you get to -- you get to  
4 pick, okay.

5 My personal favorites are the white board,  
6 Dorothy, and the rapper at the construction site, so  
7 those are the only clues I'm going to give you here.  
8 So, get online and check out some videos and you  
9 could -- you could sway that.

10 The votes are actually -- it's kind of  
11 interesting that it's a three -- it's a combination of  
12 they wanted to do the social media, so I think 25  
13 percent of the score -- it's kind of like "Dancing With  
14 The Stars," 25 percent of the votes come from your  
15 social media skills and how many friends and relatives  
16 you have.

17 The Girl Scout, who is plumbing the Girl Scout  
18 National Network for her merit badge, and maybe her  
19 silver or gold Girl Scout award is way ahead in the  
20 voting, okay.

21 And then the judges are Miss Oklahoma, the  
22 Secretary of Technology for the State of Oklahoma, and  
23 the Secretary of Energy for Oklahoma, so it's kind of --  
24 so, you have the social side, and the science side, and  
25 the industry side are the judges. And all that will

1 happen in two weekends they'll announce the winner, so  
2 pretty cool thing.

3           So, go to the "Go-Go GEO Challenge" and cast  
4 your vote before midnight tonight, Central Mountain  
5 Time, so don't forget you're a time zone off here, two  
6 time zones off.

7           And again, just to reinforce that, if you look  
8 on the white board there, every video you get like a 30-  
9 second primer on why ground source heat pumps are cool.  
10 Three major manufacturers all supporting the same  
11 advertising and program with the utility and that's  
12 where we need to be to grow this industry, not only in  
13 California, but in the country.

14           This is some work that's about ten years ago,  
15 maybe a little longer now, where we got some national  
16 focus groups together. It was under a program called  
17 "CO-Z". CO-Z was a turnkey programmer, basically sign a  
18 contract with the utility for a flat monthly fee, get  
19 your ground source heat pump installed with the loop at  
20 a guaranteed temperature setting.

21           So, the focus groups, the company that ran the  
22 focus groups had also done focus groups for kind of a  
23 technology you might be familiar with, called anti-lock  
24 brakes. You know, anybody -- you step on the pedal and  
25 it keeps you from like skidding and dying in a fiery

1 auto crash.

2 In the initial customer focus groups more people  
3 were interested in getting a single monthly price  
4 heating and cooling system from the utility than were  
5 interested in anti-lock brakes, when they focused  
6 grouped anti-lock brakes.

7 So, customers are more interested in having the  
8 utility help them with their energy bills than they are  
9 saving their families from a fiery auto crash is the  
10 only way I can summarize that data.

11 (Laughter)

12 MR. BONY: That's huge. So, your consumers are  
13 basically saying lease me my energy-efficient green  
14 system for a flat monthly fee and I'm all over it. But  
15 if you ask me to come up with a \$30,000 check, that's  
16 kind of hard for me right now, right.

17 So, this is -- this was the first -- if you've  
18 not heard the term "on-bill financing," or "on-bill  
19 collection," where the utility basically puts the money  
20 up, you make the investment in energy efficiency. You  
21 can only buy stuff that has a positive cash flow. It  
22 was basically the response after Property Assured Clean  
23 Energy, or PACE, went belly up. I know California's --  
24 how's your lawsuit coming on that, I haven't read  
25 anything in a --

1           MR. LOYER: We're doing all right.

2           MR. BONY: Are you doing okay? I'm rooting for  
3 you, don't get me wrong.

4           But, basically, on-bill financing was the  
5 response when PACE got messed up.

6           The meter, the electric meter, or the gas meter,  
7 or the water meter becomes the anchor point for the  
8 payback of the loan. Okay, so you get the improvement,  
9 whoever lives in the building and pays the bill pays off  
10 the loan, so the risks of default are very low. And it  
11 decouples the consumer's desire to have a better  
12 building from an energy stand point, from the fear of  
13 being stuck with a payment that may follow them, while  
14 the next person in the building gets the benefit, okay.

15           A co-op in Kansas, Midwest Energy invented on-  
16 bill financing. And, basically, I like it for a couple  
17 of reasons and it's a great utility example. The  
18 utility can -- the utility, basically, won't loan you  
19 the money unless it's cost effective, right. So, you  
20 can't put the \$30,000 Pella window package in that cuts  
21 your energy bill by 10 percent, right, you have to do  
22 stuff that -- but if your windows, if you need to  
23 replace some windows and you've done other things that  
24 really do provide energy savings, like putting  
25 insulation in a totally un-insulated attic, or putting

1 in a ground source heat pump system, you can spend up to  
2 your payback.

3 In this case, they leave about a 10 percent  
4 buffer.

5 It's a huge opportunity for the program to help  
6 their consumers. And if the utility doesn't want to be  
7 the bank, then you just change the name a little bit and  
8 instead of calling it on-bill financing, you call it on-  
9 bill collection. The utility gets an administrative  
10 fee; some third-party investor puts up the money.

11 And ground source heat pumps, wherever I do the  
12 math, at somewhere between six and seven and a half  
13 percent interest, ground source heat pumps provide a  
14 positive cash flow.

15 Do you know how many insurance companies and  
16 pension funds would love to get their money out of a one  
17 percent interest bearing account to get into a six or  
18 seven percent return fund that's basically insured by  
19 the electric meter, right, so another opportunity for  
20 utilities to play in the space.

21 And then this report came out before Dr. Liu's  
22 report and it basically said -- it was this whole primer  
23 that said, wow, having the utility own the loop really  
24 does make sense. Why don't we -- you know, customers  
25 don't buy power plants. When we offer a line extension

1 as a utility we make them pay for the poles and the  
2 wire, but we don't make them at least pay for the power  
3 plant upstream. So, why do we think people are going to  
4 make this 50-year investment in renewable energy  
5 infrastructure up front, when we don't do it with any  
6 other utility service?

7           So, they created, basically, the term, the  
8 ground loop utility, so it gives you the opportunity --  
9 I called it you could buy your energy efficiency by the  
10 drink, not by the bottle, once upon a time.

11           And the utility can keep the carbon credits  
12 because it's their money, so it has all these  
13 opportunities for the utility, again, to convert the  
14 incremental costs for a ground source heat pump into a  
15 life -- into a levelized payment stream that takes that  
16 first cost out of the hands of the consumer. So, the  
17 consumer gets total -- lower total energy bills, the  
18 utility grade service, the utilities there to make sure  
19 that the quality control's in position, this works for  
20 residential and commercial, and it levels the playing  
21 field.

22           And then, when you throw tax credits on top of  
23 that, it actually makes the playing field tilted towards  
24 ground source.

25           The Feds like this so much this actually went in

1 the last Farm Bill we passed, which was when Secretary  
2 of Interior Salazar, who's no longer the Secretary of  
3 Interior, was actually a Senator from Colorado, the RUS  
4 already lets co-ops borrow money to own loop fields, and  
5 they have had for almost eight years, now.

6           And the Federal tax credits on commercial, we  
7 talked about that earlier. Basically, if you're doing a  
8 commercial building and you have a tax appetite, and  
9 you're not putting in ground source heat pump, you're  
10 leaving money on the table. I mean, because you're  
11 going to get the best equipment, the longest lifecycle  
12 benefit, and you're probably going to have a payback of  
13 five years or less and, in most cases, shorter than  
14 that.

15           So, that came out of the -- the ability for the  
16 RUS to loan money to co-ops for the loops came out in  
17 2007. That was actually the committee language that  
18 made it happen and thanks to former Senator Salazar for  
19 that.

20           There is the Federal tax credit, so residential  
21 gets a third, the Federal tax code you get 10 percent,  
22 plus, plus, plus, plus, plus.

23           This is what we're doing in my home state of  
24 Colorado. They're actually, in this legislative  
25 session, we think we're going to introduce a renewable

1 thermal energy standard. So, it brings all the red-  
2 headed step-children to the party, ground source heat  
3 pumps, thermal solar, solar thermal, and biomass,  
4 basically, the burning of biomass to make electricity or  
5 heat, okay.

6 And it's focused on Btus, not kilowatt hours.  
7 Again, why? Because the carbon lives in the Btus, not  
8 necessarily the kilowatt hours.

9 The United Kingdom, I don't know if you've got  
10 any of their stuff in there, but they basically have a  
11 ground source heat pump initiative. Why would the UK  
12 want to go all ground source heat pumps?

13 Well, when the North Sea gas started to run out,  
14 their choices were to get gas from Russia. Now, maybe  
15 from Pennsylvania, you know, if we can get that shale  
16 gas into tankers and ship it out of New Jersey.

17 But, basically, they didn't want to have their  
18 economy be dependent on important natural gas when they  
19 lost their reserves out of the North Sea.

20 So, they call theirs the "Renewable Heat  
21 Incentive." They're basically buying renewable heat,  
22 including ground source heat pumps, as a national  
23 policy.

24 Maryland is probably the leader in state policy  
25 in their HB 1186, which was signed about a year ago.

1 They basically, as part of their RPS, and they were  
2 concerned that they weren't going to have the conditions  
3 to meet their RPS with renewable from photovoltaic and  
4 wind. So, now, they're converting the energy savings  
5 from ground source heat pumps into Btu equivalents, and  
6 the utilities can apply those Btu equivalents towards  
7 their RPS requirements, okay.

8           And then their homeowners actually can get RECs  
9 for ground source heat pump systems. That started in  
10 January of this year. So, that's that legislation.  
11 There's a workshop actually coming up on that in a  
12 couple of weeks.

13           So, there's all the folks when they signed the  
14 bill. And it started, I want to point that out, it  
15 started out with a meeting like this.

16           Yeah, I've got -- I've got a minute left, I'm  
17 watching the clock there, okay.

18           The exciting thing is now Baltimore Gas &  
19 Electric, which hated the RPS, is going wait a minute I  
20 can cut my peak, fill my valley, and get my RPS credits,  
21 right. So, suddenly, the utility that was saying we  
22 hate RPS is going, well, let's take another look at  
23 this, so that's pretty huge.

24           There -- and I put this up because you're going  
25 to talk about barriers and stuff, first-cost hurdles are

1 their barrier they identified. Effective legislation,  
2 which is what they think they've done. And now they're  
3 focusing on increasing awareness in the whole community  
4 from consumers, commercial building owners, architects,  
5 engineers, and their workshop is going to be at the end  
6 of this month if you're interested, and you want to fly  
7 to Maryland.

8 Wyandotte Municipal Services, a small version of  
9 SMUD, implemented their ground source heat pump tariff  
10 as utility-owned loops in August of 2010. Why? They  
11 own a coal plant and if they lose the coal plant, they  
12 use the coal generation that feeds the plastic plant,  
13 which is the largest employer in the city.

14 And by the way, the cogen steam goes to the  
15 hospital, which is the second largest employer, and et  
16 cetera, et cetera.

17 So, basically, they think if they converted all  
18 of their homes to ground source heat pumps, they would  
19 offset the carbon emissions from their coal plant, which  
20 drives their whole utility-scale and community-scale  
21 model.

22 New York City is going to pass pro grounds for a  
23 C pump legislation probably next month. For health,  
24 basically, particulate emissions, they have a lot of  
25 fuel oil they still burn in New York and they want to

1 get rid of that. So, the city council's already passed  
2 some pro grounds for a C pump language and they're going  
3 to basically authorize a city study to identify retrofit  
4 sites for ground source heat pumps, if the legislation  
5 they're bringing up next month passes.

6           And in closing, there's just a couple of policy  
7 things we need to take care of. Fuel switching is a big  
8 one, right. So, why is converting electricity to  
9 natural gas good if the electricity doesn't have any  
10 carbon in it, right?

11           And why can't -- why isn't switching 500-percent  
12 efficient electric ground source heat pumps that can be  
13 powered by renewable energy bad, especially if you're a  
14 propane or a fuel oil customer and you have no other  
15 option?

16           Shale gas, I know California's got kind of  
17 worried about becoming dependent on gas from outside of  
18 the area.

19           And then the whole CO2 emissions, I would -- if  
20 there's any university professors in the room, or  
21 retired university professors in the room, I want to see  
22 the study that says how much unburned methane is  
23 escaping from an unturned residential furnace, and then  
24 we'll multiply that times 21 times to get the CO2  
25 emission equivalents for that.

1           So, in closing, you know, we can always count on  
2 the regulators to do the right thing after exhausting  
3 all other options, and I think we've gotten to the final  
4 option here.

5           And I'm just a few minutes over but, you know, I  
6 was really into it and I didn't want to quit so --

7           (Laughter)

8           MR. BONY: Thank you.

9           MR. LOYER: Thank you, Paul.

10          Well, at this point we'll be taking questions.  
11 And we're just a little bit over, but we'll take  
12 questions from people in the room, first. So, are there  
13 any questions for this panel?

14          MR. SPLITT: Yeah, I'll ask some questions.

15          MR. LOYER: Yeah, just state your name for  
16 everybody online.

17          MR. SPLITT: Okay. I'm Pat Splitt from App-Tech  
18 in Santa Cruz. I'm an energy consultant, also design  
19 hydronic systems, including, occasionally, ground source  
20 heat pumps, when I can figure out how to do it.

21          But the only question I had for this period is  
22 for Marc, and that was in the comparison of the  
23 different levels of building performance, where he was  
24 comparing Title 24 to the Tier 2.

25          The basis for Tier 2 is being 15 percent better

1 than Title 24, which means you have to model the system  
2 with the residential compliance software, and there's no  
3 way of inputting COPs and EERs. So, I'm just trying to  
4 figure out what the point of the whole exercise was if  
5 it's not possible to install that system in California  
6 right now.

7 MR. HOESCHELE: I'm on here.

8 MR. LOYER: Okay.

9 MR. HOESCHELE: So, your question is how did  
10 we -- how did we model the Tier 2 or what did we assume,  
11 or just modeling the geothermal system?

12 I'm just repeating what I said before. So, I  
13 can't look and talk at the same time. So, the -- I  
14 mean, I actually didn't do the modeling; the author  
15 couldn't make it here. But my understanding is, you  
16 know, we ran the package of measures under Title 24 and  
17 then ran -- and all this -- I mean, so that was done in  
18 compliance software.

19 And then the geothermal was run in the eQUEST-  
20 02. So, we're not -- we're kind of modeling so-called  
21 real performance, not how Title 24 would model it.

22 MR. SPLITT: But the reference for Tier 2 is  
23 that somewhere you had to show that it exceeded Title 24  
24 by 15 percent. And the only way to do that is to model  
25 it with compliance software. And the compliance

1 software cannot take an input of EER and COP.

2 So, when you listed the barriers, this seems to  
3 me to be the biggest barrier at all, is that we can't  
4 model it.

5 MR. HOESCHELE: Right. No, it certainly is a  
6 barrier for Title 24 with the way geothermal's handled.

7 MR. SPLITT: Okay. Well, I think some of it  
8 should have gotten in there that you really made an  
9 assumption that you couldn't verify.

10 MR. HOESCHELE: Well, I can't speak to the exact  
11 answer since I didn't do the math.

12 MR. SPLITT: Well, but since he's not here I'll  
13 speak for him.

14 MR. HENRY: It does seem that that study, as you  
15 just said, Marc, speaks to -- it takes a Title 24  
16 compliant structure as a given and then applies ground  
17 source heat pumps to it, and then you look at the  
18 savings. That's what it seemed. From reading that  
19 study, that was my understanding.

20 And then that subject, I think, will come in  
21 detail in the next session.

22 MR. LOYER: Yeah, and I was just actually --  
23 Marc, do we have that study on our website, yet? Have  
24 you given that to us, yet?

25 MR. HENRY: Oh, do you want to speak to this?

1 MR. HOESCHELE: Well, you have the microphone.

2 MR. HENRY: Yeah, and a big voice. So, that  
3 study is not available as of yet. Davis Energy is  
4 working to get authorization from PG&E to make that  
5 study available to the public so, stay tuned.

6 Dave Springer indicated that probably wouldn't  
7 be a problem. It's a great read.

8 MR. LOYER: So, the question is whether there  
9 was any hot water in that study.

10 MR. HOESCHELE: No.

11 MR. LOYER: No. And the answer is no.

12 Are there any other questions? No, all right.

13 MR. HOELLWARTH: Oh, Craig Hoellwarth,  
14 California Energy Commission.

15 In Paul's discussion there was a lot of talk  
16 about utility programs related to policy. The states  
17 have policies toward utilities. Is there anyone here  
18 from the Public Utilities Commission or anybody online  
19 that can enter into the conversation, once we have it?  
20 No.

21 MR. LOYER: And I'm not seeing any hands raised  
22 online or any indication from anybody online so --

23 Okay, are there any other questions that we can  
24 get to at this point? You mean comments into the  
25 process? Yes, yes.

1           MS. BROWN: So, it's a little awkward to speak  
2 with my back to the crowd here. My names -- I'll to  
3 look this way. My name's Elise Brown. I'm with the  
4 California Geothermal Energy Collaborative at UC Davis.  
5 And this is really awkward. No, that's fine.

6           Anyway, I just wanted -- I was made aware of  
7 this workshop because of the list serve, and I think  
8 that you may be in a different division, but I wanted to  
9 make the Commission aware of some of the work that we've  
10 done on geothermal heat pumps.

11           The CEC funded -- so, I'm part of the Energy  
12 Institute at UC Davis, and the California Renewable  
13 Energy Center there. We're the Geothermal  
14 Collaborative. We do work on geothermal electric, but  
15 also on geothermal heat pumps.

16           And last spring we submitted, though it hasn't  
17 been published, yet, but we submitted a pretty  
18 exhaustive study of geothermal heat pumps and their  
19 efficiency in the 16 California climate zones. So, that  
20 has been modeled and it's sitting at the CEC.

21           I'm sure I can give you our contract manager's  
22 name and I'm guessing he'd be willing to share that with  
23 you. I can't, as you understand.

24           So, you know, we had great results. It was  
25 found that in all -- well, in 15 of the 16 climate zones

1 geothermal heat pumps were certainly more efficient than  
2 traditional HVAC.

3           In the climate zone that it was not more  
4 efficient it was equal to, and that was in El Centro  
5 where it's just really hot all the time.

6           So, and we not only modeled efficiency, but we  
7 also modeled CO2 savings, NOx savings, and SOx savings,  
8 as well.

9           So, that is there and I just want to remind you  
10 that we're a resource.

11           If you're looking for national data, we are  
12 working with the DOE right now on a national report for  
13 the 30 most populous metropolitan areas, a similar sort  
14 of study. But we're doing or modeling not only  
15 residential, but also commercial buildings in that.

16           And working with PG&E -- to just sort of ground  
17 truth our data in Davis, and Lisa is helping us with the  
18 engineering on that.

19           So, just wanted to make you aware that we are  
20 resource, and available, and close, and happy to  
21 participate.

22           MR. LOYER: And I think the study you're  
23 referring to is through our PIER Program, if I'm not  
24 mistaken.

25           MS. BROWN: It is. It is.

1           MR. LOYER: Okay. Yeah, we did get an early  
2 draft of that but, you're right, it's not ready for  
3 release yet, as far as I understand, yet, so --

4           MS. BROWN: Yeah. Well, it just needs to be  
5 published. I don't know what's holding it up.

6           Okay, so that's all. Thanks.

7           MR. LOYER: Any more questions or comments?

8           Yeah, Dan.

9           MR. BERGOYNE: Dan Bergoyne with the California  
10 Department of General Services. I just wanted to get a  
11 little clarification whether the ground source heat pump  
12 also provides the domestic hot water supplies. I'm  
13 seeing nods, so I'm assuming that it's not only heating  
14 and cooling, but also domestic hot water.

15           And then the cost of a -- there was discussion  
16 about the cost of a retrofit for a home, as an example,  
17 and I heard numbers of \$30,000 being thrown out. Is  
18 that a typical cost for a retrofit of a standard home?  
19 Good, good, because my utility bill is about \$1,500 a  
20 year, gas and electric combined, and at a 50 percent  
21 savings at \$750 a year, that would take a lot of years  
22 to pay for a heat pump system, so I'm just kind of --  
23 and, you know, a lot of the examples I'm seeing are on  
24 the residential side but, you know, it seems to me and  
25 I've heard a lot more examples in California of heat

1 pumps on the nonresidential side, and I'd be interested  
2 to see more cost studies and savings information on the  
3 non-commercial side.

4 MR. LOYER: And I think, and Paul and Phil, you  
5 can jump in here as well. We have, actually, a couple  
6 of studies, I think, that show the cost savings for  
7 commercial side applications.

8 I'm not so sure they're in California, though.  
9 I think these are both -- the ones I'm thinking of are  
10 both national studies.

11 I would, just as a -- just based on my very  
12 imperfect knowledge of the ground source heat pump, and  
13 their application, I would guess that the -- if we can  
14 make it cost effective for a residential application, it  
15 should be fairly reasonable that we're going to make it  
16 cost effective for a non-res application as well, even  
17 more so. It should be much easier for a non-res  
18 application. But yeah, you know.

19 MR. KAVANAUGH: Just a comment. And as you  
20 know, most of the work I've done is in the commercial  
21 arena but, you know, my heart's in residential, okay.  
22 Right now in Alabama, a three-ton, 13 or 14 SEER heat  
23 pump system goes in at about \$6,000, \$6,500, okay.

24 So, if you're looking at a ground loop that  
25 costs \$2,000 to \$3,000, that does not add up to \$30,000.

1 But I will tell you there are systems going in where  
2 customers are paying \$30,000 for their ground source  
3 heat pumps, three and four ton systems. So, where's the  
4 math? I don't know.

5 When you have to pay \$7,000 or \$8,000 just for  
6 the heat pump there's the problem, a huge problem. And  
7 our goal should be to make mass-produced heat pumps that  
8 cost pretty much the same or less than a 13 or 14 SEER  
9 split system heat pump. That should be our goal. And  
10 when that is done on a widespread basis for schools, and  
11 residences, modest homes then we'll be much less than  
12 half of what \$30,000 is. But you are seeing \$30,000  
13 three and four ton heat pump systems going in, in the  
14 residential sector.

15 Why? Don't know.

16 MR. LOYER: And were there any other questions,  
17 any other hands?

18 Let me just check the online crowd here and see  
19 if there are any hands raised here. And seeing none,  
20 and I don't have any phone-only call-ins, so I think  
21 about a five-minute break, and then we'll go into the  
22 session three. All right, thank you.

23 (Off the record at 3:06 p.m.)

24 (Resume at 3:20 p.m.)

25 MR. LOYER: All right, we're going to get started

1 again. We need to wrap up session three so we can get  
2 to the Round Table.

3 I'll be a little more booming. We're running a  
4 little bit late, folks, so --

5 All right, welcome back, we're going to start  
6 session three here.

7 Session Three's title, "What needs to be done  
8 for California to realize the benefits of ground source  
9 heat pumps?"

10 And I think this is the session most everybody's  
11 been waiting for, this and the Round Table I think  
12 promise to be very entertaining, if nothing else.

13 MR. HENRY: Yeah, absolutely. Absolutely.

14 MR. LOYER: Oh, go ahead.

15 MR. HENRY: We're running a bit behind and I  
16 know, I want to make sure there's plenty of time for the  
17 two presentations that follow behind. It's important  
18 information.

19 And I'd rather cut mine short than rush either  
20 of the two of them.

21 So, if there's something that needs more  
22 discussion or I didn't convey, or I skipped over in the  
23 barriers piece, it's because of expediency. Approach me  
24 afterwards, or bring it up in the strategic planning  
25 session, or if you feel like relaxing a bit we're going

1 to adjourn to de Vere's, over on L Street, after the  
2 workshop. And for those of you attending remotely, I  
3 know a number of you are probably in town and attending,  
4 maybe after your work is over you can come down and  
5 continue the discussion.

6 So, with that, I was tasked with speaking to the  
7 barriers and, to some extent, perhaps, how they relate  
8 to, you know, why we needed a piece of legislation in  
9 the first place.

10 And AB 2339 simply -- came about simply because  
11 everything industry had been doing for the last many  
12 years was just not working. And so, rather than beat my  
13 head -- you know, continue to beat my head against the  
14 wall, so let's figure out what we can do differently.

15 Well, one thing that we hadn't been successful  
16 at is having a statewide discussion on the technology,  
17 it hadn't happened.

18 And two, we hadn't -- I was not aware of any  
19 legislation in California that focused on the  
20 technology. And so, we got together last January 31st,  
21 put forth the idea to do it differently, and that  
22 resulted in 2339 being signed into law.

23 It resulted in, even before it was signed into  
24 law, starting a statewide conversation and here we are  
25 today continuing that conversation.

1           So, the basic question coming out of the last  
2 session is if geothermal heat pumps are so great, why  
3 does California rank at the bottom of the list in terms  
4 of per capita deployment?

5           You can look at Dennis Murphy's Project  
6 Negatherm, he digs into this pretty aggressively and in  
7 a very refreshing way. And you can read what's on the  
8 slide, but the short version is we are not a leader in  
9 this technology, period.

10           California is historically a leader in matters  
11 that have to do with energy and in this particular  
12 technology we are behind the curve, way behind the  
13 curve. And my goal, my mission in life is to change  
14 that.

15           Here's the real answer to why we're at the  
16 bottom, the barriers. The barriers. And when I was  
17 putting together this particular slide there was one on  
18 the net that actually had a fellow with a -- you know,  
19 rubbing his head and the caption was, "God, it felt so  
20 good when I stopped banging my heat against the wall."

21           And I experienced that last year when we hired a  
22 lobbyist and sponsored legislation, it felt very good  
23 and continues to feel good.

24           Taking a different approach has evolved a  
25 relationship between industry and the Energy Commission

1 into a collaborative effort towards some common causes,  
2 and that's very, very refreshing and proving to be  
3 fruitful.

4           So, when you look at or examine the issue of  
5 barriers to this technology there's two excellent pieces  
6 of work. One is the report by Patrick Hughes. It's  
7 kind of a long title, "GHPs Market Status Barriers to  
8 Adoption and Actions to Overcome Barriers." It was  
9 published in 2008. I don't read much because I don't  
10 have time. I read this cover to cover many times,  
11 right.

12           And it quickly became the benchmark, the  
13 benchmark treatise on this subject for the industry.

14           And then the second piece is the PIER Program  
15 Project Negatherm. There's Project Negatherm for Ground  
16 Source Heat Pumps -- Improving Geothermal Borehole  
17 Drilling Environment in California." And the principal  
18 investigator is in the audience, Dennis Murphy, sitting  
19 back there in the back.

20           So, both of these are up on the website. I  
21 encourage you to dig into them. They're quite lengthy  
22 and you'll probably enjoy the read.

23           And then in terms of barriers, themselves, I put  
24 them into two basic groups. One is barriers that are  
25 endemic to the technology and in many ways endemic to --

1 in some ways endemic to any new or emerging technology,  
2 right, but we're going to focus on GHP.

3 And then the one that -- the barrier that I  
4 do -- that I work on every day, trying to address, the  
5 class of barriers that is the basis for the need for AB  
6 2339 are the barriers that are self-inflicted. We're  
7 actually creating them.

8 It's not -- they're not coming about because the  
9 sun comes up in a different way in California or there's  
10 something out of our control. They're self-inflicted  
11 barriers and, predominantly, they're regulatory and  
12 systemic barriers.

13 You can go to AB 2339.org, which was a website  
14 put up to assist in the outreach in the AB 2339 effort  
15 and you can get some good information on that, on the  
16 bill, itself, and what it took to get it through  
17 legislation.

18 So, starting with Patrick Hughes' report, he  
19 proposed -- he lays out five or six barriers. Now,  
20 we've talked about these indirectly and directly today.  
21 One is the high first cost, oftentimes high -- perceived  
22 high first-time cost to consumers. Paul talked quite a  
23 bit about some solutions to overcome that; lack of  
24 consumer knowledge or confidence in the systems on the  
25 part of the consumer, specifically; lack of policymaker

1 or regulator knowledge and trust in the GHP systems.

2           And I just want to stop there for a second. I  
3 didn't have this in but it occurred to be driving into  
4 town this morning, is when a consumer or someone hears  
5 factual data on the technology for the first time,  
6 somewhere in that conversation, it happens almost every  
7 time, there's a little ah-ha moment and they get it.

8           GHP is a pretty cool technology. And so when  
9 it -- and I've experienced that countless times in the  
10 last dozen or so years that I've been in this industry.

11           The same thing occurred a few blocks away in the  
12 Capitol Building, right. The legislators heard about  
13 the technology, had to read about it, had to get briefed  
14 by staff, right, and then make a decision either in  
15 committee, or in the Senate floor, or the Assembly  
16 floor, right.

17           And their way of saying I get it or I don't get  
18 it is a yea or nay vote, right.

19           In all the committee hearings, all of the floor  
20 votes in the Assembly and the Senate, there was one no  
21 vote, right.

22           So, that tells me there's a common message  
23 there, right. There's opportunity for folks to get it,  
24 we just need to get the word out and then get out of the  
25 way of industry and let market forces come to bear. And

1 that was really the whole point of AB 2339.

2           There are certain limitations in the design and  
3 business infrastructure, limitations on the installation  
4 infrastructure, very big in California. That is a big  
5 part of the high drilling costs in the State. And then  
6 lack of new technologies and techniques to improve GHP  
7 system costs and performance.

8           And if you have a conversation with someone who  
9 has been in this technology -- I'd love to see what Dr.  
10 Kavanaugh has to say, he's been in the industry for a  
11 long time.

12           But in all the conversations that I've had with  
13 the very old-timers, these same items right here are on  
14 the list they had 20 plus years ago. You know, this is  
15 not new information. You know, we're still trying to  
16 attack fundamental barriers to the technology.

17           And I'd like to see California take a leadership  
18 position and get all of these addressed in a big way,  
19 and show the rest of the country how you can get  
20 business done in the State. That's my objective.

21           There's one -- there's one item that is kind of  
22 hinted at in Patrick's report, talked to a little bit,  
23 but for whatever reason he doesn't come out and say it.

24           I'll say it, a big barrier -- and this could  
25 really go over in the self-inflicted side, I think,

1 we've talked about it today, we heard quite a bit from  
2 Lisa and Dr. Kavanaugh on this topic, and the -- and  
3 that's the level -- that's the level of skills that  
4 exist in the professional engineering community in this  
5 state, in other states, and in Canada. And I've worked  
6 in all of those areas.

7 I've dealt with projects on the planning side,  
8 conceptual side, and I've dealt with on the forensic  
9 side, all right.

10 And the fact is that a PE behind your name does  
11 not qualify you to design a geothermal heat pump system.  
12 It does not, right. That PE needs some specialized  
13 information. It's not that these systems are  
14 complicated or rocket science, because they're not, but  
15 it requires paying, I think, more attention to  
16 conservation of resources, looking at the entire system  
17 as a system, and recognizing what you don't know and  
18 reaching out and getting that information.

19 And when an engineer reaches out and gets the  
20 information, and then does the design, you get a high-  
21 performing project.

22 When you don't, the manufacturer's probably  
23 going to get a call and say these heat pumps don't work,  
24 or the driller's going to get a call, these loops don't  
25 work or, man, I knew it didn't work in California. Well,

1 it's because the fundamental design was inadequate.

2 I don't know if I can hit that one any harder.

3 Specifically, the rest of this will be about the  
4 regulatory and systemic piece.

5 In my dealings with the Energy Commission over  
6 the years I've been told things like GHPs don't work,  
7 they don't work in California, and I've been asked where  
8 is the industry, right.

9 The GHPs do work. They do work in California  
10 and this workshop is about changing that conversation to  
11 a factual-based conversation, clearing up  
12 misconceptions, and figuring out how we move forward in  
13 a constructive way.

14 As far as the industry goes, industry was one of  
15 the barriers in California. No doubt about it.

16 And as we decided back in that meeting on  
17 January 31st, where we decided to sponsor legislation,  
18 we also decided to organize the industry.

19 And the first step was forming a lobby coalition  
20 called CalGeo. CalGeo sponsored the legislation a few  
21 months later, May 21st -- yeah, another 21st there. The  
22 California Geothermal Heat Pump Association was  
23 incorporated and we've been organizing that ever since.

24 So, we can check that off the list of barriers,  
25 at least I hope we can.

1           Now, we get into something that was of big  
2 interest to the folks on the Capitol. This is a big  
3 issue for anyone in the industry. This is the basis  
4 for, part of the basis for the high, extremely high loop  
5 installation costs. This is a major reason and why so  
6 few people have heard about it. It's a major reason for  
7 drillers and contractors not getting into the industry.

8           And in this State right now we have a, what I  
9 call, a regulatory quagmire when it comes to permitting  
10 and installing loops.

11           And there's two reasons for it, okay. One is  
12 the geothermal heat exchange wells that the DWR put  
13 forth were put forth as draft, back in 1999, and that's  
14 all the State has, right, they're still drafts.

15           The good news is and Julie will -- Julie Haas  
16 will be updating us on this, is that DWR has taken  
17 action on that issue and said we're going to fix it.  
18 And last year they went on record to say we're going to  
19 fix it, we're going to rewrite the standards and we're  
20 going to have it done in summer of 2013, and they've  
21 been working hard on doing that.

22           And CaliforniaGeo supports their effort. We're  
23 trying to assist their effort in any way we can. We  
24 took our version and with Lisa's lead, Lisa Meline's  
25 lead and generated our own standard to help that

1 process. And so, I'm very optimistic that we soon will  
2 have a well-vetted working standard of construction for  
3 boreholes in the State, very optimistic.

4 That's going to leave us with another problem,  
5 right, and that is the current definition of a borehole  
6 in California's Water Code starts the confusion that  
7 exists around this. It refers to a borehole as a well,  
8 right.

9 These are not wells, these are boreholes. You  
10 might think that's a minor issue, you know, get off your  
11 bandwagon, Phil, but when you go out to the counties and  
12 the various permitting authorities that are trying to  
13 get their head around how to permit, how to inspect, how  
14 to regulate, and they go back to the primacy documents  
15 and the standard is not really a standard, it's a draft,  
16 and the code says -- calls it a well, it's a pretty high  
17 likelihood that when they go to generate a price, and  
18 it's a permitting and inspection protocol, that they're  
19 going to charge a well permit price per borehole on that  
20 five-borehole in the house, at \$600 to \$1,200. That's,  
21 you know, getting up -- that's approaching a third of  
22 the cost of the loop. It's kind of hard to be cost  
23 effective.

24 So, this year I think we'll see huge changes in  
25 this particular picture with DWR at the helm.

1           Another fundamental barrier, the fact that the  
2 technology is not included in the IEPR and virtually any  
3 other place, as CEC materials, other than some very  
4 valuable studies from in the '90s, we're just not  
5 included anywhere, right.

6           And, particularly, the IEPR, which means we  
7 don't get a seat at the table, we don't get to be in the  
8 discussions around on-bill financing programs, right.  
9 We don't get to -- if it wasn't for this workshop, and  
10 the visibility, and the mandated inclusion of the  
11 technology in the 2013 IEPR, we'd probably not have a  
12 seat at the table when it comes down to SB 758  
13 implementation. We sure the heck wouldn't be part of  
14 the party in the Prop. 39 implementation.

15           Both areas we can play a significant role.  
16 We've heard a lot about how that role -- what that role  
17 can be today.

18           So, we've got to have a seat at the table, we  
19 deserve a seat at the table, and we will have a seat at  
20 the table, we have it now, so another part of 2339.

21           Another huge barrier and it's come up in  
22 a few different talks today is the tier grade structure  
23 that we live under. It absolutely dis-incentivizes  
24 geothermal heat pumps.

25           You know, so you get a residential customer that

1 says I want to do the right thing. You know, I don't  
2 mind, you know, paying a lot up front to get these  
3 benefits, right. So, they get the system installed,  
4 let's take a PG&E customer, and so they see their  
5 utility bill, electricity bill go down in the summer,  
6 which is cool. It's very cool especially when you're in  
7 the very high heat conditions, right.

8           You see your gas bill go down next to nothing,  
9 depending on what you continue to burn gas for.

10           But you see your electricity bill go up in the  
11 wintertime. Now, it doesn't matter -- it doesn't matter  
12 whether you look at the summer or the wintertime usage,  
13 we're up in the higher tiers, right. It's painful.  
14 It's doubly painful on a geothermal heat pump system.

15           And how we solve that? You know, maybe GHPs or  
16 similar technologies get a preferential rate. Or maybe  
17 the tiered rate structure goes away in California. That  
18 would be a novel idea.

19           And then this next barrier is one Pat Splitt was  
20 speaking to Marc about, and that's the status of the  
21 Title 24 compliance software, and the ACM, and the whole  
22 modeling picture.

23           I'm not going to dig into this very much, others  
24 will be able to speak to the current state of affairs  
25 right now. It is a huge problem when a design engineer

1 can't properly demonstrate the impact, not fudged  
2 impact, but the actual impact on Title 24 compliance  
3 when they install a geothermal heat pump system. That's  
4 something we need to get fixed right away.

5           And then the HERS rating and inspection  
6 protocols, they just, to my knowledge, and correct me if  
7 I'm wrong here, they're not defined for GHP, right.

8           So, let's say we're successful, we're in the  
9 IEPR, we get the tiered rate structure fixed, the Title  
10 24 compliance issue is fixed and we're installing a  
11 bunch of system. Well, how do they get inspected,  
12 right?

13           You know, if the HERS rater goes out to the job,  
14 a residential project, perhaps, and starts pulling out  
15 refrigerant gauges, checking refrigerant level in that  
16 packaged heat pump that's going to be a huge mistake.

17           We need to get protocols in so they know how to  
18 go do their job. And if those are properly developed,  
19 the building officials can also use much of that -- much  
20 of those protocols and that body of work to develop  
21 their own local inspection programs for the technology.

22           How are we doing on time? God, I'd love to get  
23 into this one but I'm just -- let's talk about this one  
24 later.

25           Okay, I think I can get this one in and close.

1 So, there's been discussion, recent discussion on what  
2 is -- are geothermal heat pumps an energy efficiency  
3 measure or are they a renewable energy technology?

4 My position is they are both an energy  
5 efficiency measure and a renewable energy technology.  
6 And we heard today the work that's being done in the GHP  
7 system is based on that, what's in the ground, in that  
8 loop, that's the renewable piece.

9 And I'm hoping there will be a paradigm shift  
10 within the Commission, and elsewhere, on this issue and  
11 not let it continue to be a barrier. Somehow we can  
12 coexist and be both.

13 And it's interesting that AB 2339 started out  
14 being directed to the PUC and was quickly redirected to  
15 where it intended it to be, and that's to the Energy  
16 Commission.

17 And what had happened in that process, the PUC  
18 came out both feet against the bill, all right, which we  
19 expected.

20 But in that process we had good conversations  
21 with them and they went on the record with some very  
22 important things and I'm just going to highlight them,  
23 okay.

24 The technology could be characterized as both a  
25 renewable distributed energy resource, as well as an

1 energy efficiency resource. That's the PUC's position,  
2 right.

3           Since geothermal heat pumps impact heating, and  
4 cooling, electric and gas loads for a building they  
5 should be assessed in the energy efficiency potential  
6 studies to determine whether they provide cost-effective  
7 energy savings. If they are deemed cost effective, that  
8 goes in that present value and TDV that we'll be talking  
9 more about. If they're deemed cost effective then they  
10 would be included in the utility energy efficiency  
11 goals.

12           That's two proceedings at PUC that they're  
13 saying we fit in, all right.

14           And then, last but not least, if enacted -- skip  
15 that part of it. Qualify review within the CPU's  
16 existing customer distributed generation and energy  
17 efficiency. They're restating what they said in the  
18 previous two, so we fit in both. We fit in both, that's  
19 the point.

20           That analysis is not available online anywhere,  
21 but you can get that through the Capitol and we can  
22 figure out how to make that available, as well, okay.

23           So, just to quickly go through it, increasing  
24 deployment of GHPs will reduce the need for fossil fuel  
25 powered peak generation, improve the utility load

1 factor, provide on-site consumer energy savings without  
2 the need for rebates, all right, provide all the  
3 benefits that drive the desire for renewable energy  
4 standards without putting pressure on electric rates or  
5 ratepayers' energy bills, and increase in-state jobs.

6 Fundamentally, removing these barriers will  
7 enable market forces, business climate to come to bear  
8 and grow the industry. There you go.

9 I know I said I was going to be short, but I  
10 just couldn't stop.

11 MR. LOYER: Thanks, Pal.

12 All right, if I could ask Rob Hudler, if he's  
13 still in the room? Oh, very good, yeah.

14 MR. HUDLER: And I'm there.

15 MR. LOYER: So, go ahead and introduce yourself.

16 MR. HUDLER: Okay, so I'm Rob Hudler. I am in  
17 the Building Standards Office. I've been there since  
18 1984, so I've got a little bit of history.

19 MR. LOYER: Into the mic, please.

20 MR. HUDLER: Oh, into the mic, it doesn't carry,  
21 that's true.

22 So, what I want to try to do today is cover, you  
23 know, basically where Title 24 is at as far as the rule  
24 sets and how we look at mechanical systems.

25 It doesn't carry my voice. That's not good, I

1 can't take that.

2           And then, also, then to really talk about what  
3 paths exist within the standards that will allow us to  
4 introduce some of these new approaches.

5           So, before I start getting into the actual  
6 content I'd like to go back into history so we sort of  
7 have a perspective of where we were.

8           And, you know, 1984, Commission is rolling  
9 along, we develop our first -- or our second set of  
10 standards, second generation of standards in which we  
11 create these performance-based programs.

12           We are using 286 computers. We're using basic  
13 DOS language things. And so, the rule sets are very,  
14 very simple. And our logic is based on what is being  
15 built them, you know, the basic 1,600 square foot simple  
16 house.

17           And at that time, of course, we also had  
18 appliance regulations, which the manufacturing industry  
19 did not take kindly to, and so pretty soon we had  
20 Federal preemption laws.

21           And this is probably one of the key issues that  
22 we have to realize is that all local agencies, including  
23 states, are preempted from having different references  
24 than the Federal standard. So, the SEER became our  
25 reality, okay, as far as the beginning of the process.

1           Now, as time evolved because, obviously, the  
2 Commission didn't like SEER, we tried to find some ways  
3 to fudge with that. And so, what we essentially did is  
4 we created some rule sets that introduced the EER in a  
5 very basic way.

6           And the way we did that and, again, there's all  
7 sorts of real fancy equations in front of this, but  
8 within the RACM rule set, and I'm going to use the REV  
9 set because it's the most basic and it's probably the  
10 easiest for us to go through.

11           We essentially developed this rule set that  
12 said, you know, if you're below 82 degrees, the EER and  
13 the SEER are essentially the same. So, if you have a  
14 piece of equipment that is rated with an EER, you can  
15 use that in replacement of the SEER, okay.

16           And that's, obviously, in some cases not a good  
17 story, but at least for the ground source heat pump  
18 situation there's some benefit there. Not much because  
19 we're talking relatively cool temperatures.

20           In the temperature range between 82 and 95  
21 degrees we basically are taking the reference number, or  
22 the SEER-13, the Federal number, and slowly slide it  
23 down until we get to the 95 degree temperature, which is  
24 the test temperature for EER. And so, the overall  
25 efficiency then is adjusted to that point.

1           And then beyond 95 we just simply say it's the  
2 same number. So, it's a very, very simple logic, okay.

3           And so, from the stand point of if you could  
4 simply use your number, you guys wouldn't be in too bad  
5 of a shape. But there's another problem, we also  
6 introduced the HERS rating system. And one of the  
7 measures that require HERS verification is EER. And if  
8 you can't do the HERS verification that means your EER  
9 is a 10.

10           So, this is just a real basic little graph. So,  
11 the lower line here is showing basically the curve of  
12 what happens to a very minimal base system that, you  
13 know, it's going along and there's a slight degrade in  
14 efficiency, and then it pretty much flattens out.

15           In the case of a moderately efficient ground  
16 source heat pump you can see you can start -- you  
17 started very high in the curve, but then it takes this  
18 incredible dive down because it's trying to get all the  
19 way down to the EER 10, and then it matches the same  
20 line.

21           So, the issue is to fix that what we would need  
22 within this logic is to be able to find some method for  
23 EER verification, you know, for the ground source heat  
24 pump, and that's probably a relatively simple thing to  
25 do, okay.

1           But if we go back to this logic here in the  
2 previous slide, what we're seeing is that our whole  
3 logic is based on an air source system, okay.

4           And so, writing new rule sets and coming up with  
5 another 30 equations in front of this, so that we can do  
6 the calculation, could be a pretty monumental task.

7           But there is the possibility that we might be  
8 able to find an interim answer to be able to get to  
9 where we need to be.

10           So, the question is what is that? So, within  
11 the Administrative Regulations in Title 24 there's a  
12 Section 10-109. And, essentially, it's the compliance  
13 option. And it says, if the Commission does not have a  
14 way of modeling or addressing a system, that industry  
15 can come forward and talk to the Commission, and we can  
16 come up with a procedure to approve that new technology,  
17 whether it be modeling rules, a prescriptive approach,  
18 whatever we may end up doing, okay.

19           And the typical pathway of doing that -- well,  
20 since I have been lead on it, though I'm leaving soon,  
21 so I don't have to worry about it anymore, is I'd ask  
22 for all of the technical information I could get, I'd  
23 look at things, write up some responses, make a  
24 determination in combination with you of what was  
25 feasible, okay.

1           If it was feasible, we would go into the formal  
2 adoption process. The applicant pays a fee, they write  
3 a technical report, they have some interaction with the  
4 CEC. We write our own report. We go to a public  
5 meeting in which all your worst enemies show up and we  
6 have wonderful discussions. And if we get through to  
7 the end, we get full approval and then implementation  
8 into the standards as a compliance option for that  
9 cycle.

10           And then once that cycle of the standard is over  
11 in three years, or six months, or however much time we  
12 have, it's incorporated into the standard completely.

13           In looking at where this industry's at, and at  
14 least my personal analysis, I think that trying to sit  
15 down and do a comp up for either HERS verification or  
16 some kind of EER approval is the very fastest route to  
17 do.

18           And I think that within that, considering the  
19 technical issues I've heard, my personal recommendation  
20 would be that we do not do a HERS verification, but  
21 rather we take more of a nonresidential approach and  
22 actually have the designing engineer sign off on the EER  
23 approval.

24           Now, beyond that, if you go back to this graph,  
25 you can see that there's this little TVV impact line up

1 above there. And that may be very thin, it may be very  
2 wide. I'm not going to try and answer that question  
3 here because, again, we're talking about a lot of very  
4 complex modeling rules.

5 But the bottom line is that I think, you know,  
6 particularly for res, because res is relatively simple,  
7 we do need to start looking at introducing modeling  
8 rules that will address the issue of how ground source  
9 heat pumps should be dealt with, okay.

10 Now, you'll note the absence there related to  
11 the heating side. And the reason I did that is because  
12 right now the heating modeling rules basically take the  
13 COP/HSPF of a system, and it is constant, irregardless  
14 of the outside air temperature, okay.

15 And in the 2013 modeling rules we will change  
16 that approach to where the system is reactive to outside  
17 air. And, you know, we don't have those formulas, yet.  
18 But, irregardless, it still will not have the ability to  
19 look at a ground source system, and so a new set of  
20 rules will be required to look at that.

21 On the nonresidential side I think we're in a  
22 lot better situation because in switching to Energy Plus  
23 there's technically already modules out there for doing  
24 ground source systems, and so I think we're okay.

25 Again, the reference issue of the fact that we

1 have Federal preemption and what we use for the  
2 reference in the standard building is something that is  
3 going to potentially be challenged. And that's  
4 something that we'll have to work out over a period of  
5 time.

6 So, you know, I could get into all sorts of  
7 fancy equations and details on this but, in a nutshell,  
8 that's where the Commission stands.

9 Any questions?

10 MR. LOYER: Just one more time, Rob --

11 MR. HUDLER: Yes.

12 MR. LOYER: -- why don't you go over the final  
13 conclusion of where the Commission stands, just to make  
14 sure it's --

15 MR. HUDLER: Okay, do you want the --

16 MR. LOYER: Just that last --

17 MR. HUDLER: Related to the rule set or the  
18 preemption.

19 MR. LOYER: No, the rule set.

20 MR. HUDLER: Okay, so going back to the rules,  
21 we'll go back to the rule set. That one right there?  
22 You're sure, now?

23 Again, our logic is totally based on an air  
24 source system. That irregardless of what type of system  
25 you install, the EER/SEER and, technically, you know,

1 HSP/SCOP is all based on an outside air temperature  
2 number. There is no availability of the programs to be  
3 able to look at using ground or water temperature -- or  
4 ground water temperature as a reference on the  
5 performance scale.

6 And by including those, obviously, what you'd  
7 end up in this curve is essentially a straight line, as  
8 far as efficiency performance.

9 MR. LOYER: Great.

10 MR. HUDLER: Okay.

11 MR. LOYER: All right, I think for the moment I  
12 just want to remind everybody that we're going to  
13 entertain questions on all three presentations at the  
14 very end. So, take good notes and, Rob, we're going to  
15 lock the doors so --

16 (Laughter)

17 MR. LOYER: I think next we have Julie -- oh,  
18 good, you're here. I don't have my glasses on so I  
19 can't see that far away. We have Julie Haas, who is  
20 here from the Department of Water to speak about her  
21 subject, which is the "Geothermal Heat Exchange Well  
22 Standards Update."

23 MS. HAAS: Thank you. Okay, hello, I'm Julie  
24 Haas and I'm a senior engineer with the Department of  
25 Water Resources.

1           And I've been asked to talk to you today about  
2 our current project to update the geothermal heat  
3 exchange well standards.

4           And Phil mentioned the different terminology  
5 that's used throughout the history -- I mean, the  
6 industry for this technology. This is one of the ways  
7 they're referred to.

8           And I'm using this terminology because this is  
9 what is in the California Water Code. Because of  
10 people's associations with wells as being water wells,  
11 and that's probably not the best way to visualize these  
12 systems, I will refer to them as the acronym throughout  
13 my presentation, GHEW.

14           So, the history, just to give you some history  
15 of the well standards, in general, they date back to  
16 1949 when the Legislature recognized the importance of  
17 groundwater as a resource in California and directed, at  
18 that time it was the Department of Public Works, to  
19 investigate and report on recommended standards for  
20 constructing, maintaining, abandoning water wells.

21           And since then the Legislature has added  
22 different types of wells, requiring minimum standards,  
23 to protect groundwater quality. Water wells to begin  
24 with, then cathodic protection wells, monitoring wells,  
25 and then in 1996 GHEWs were added, and I'll talk a

1 little bit more about what those are.

2           So, in 1999, in response to that, the Department  
3 of Water Resources published this draft standards and  
4 did not finalize them. And the only significant work  
5 that was done on the well standards since, in the  
6 interim, between the current project and when the 1999  
7 standards were published, the Conference of California  
8 Directors of Environmental Health Water Well Technical  
9 Advisory Committee established a well standards  
10 subcommittee to work on making recommended revisions to  
11 the standards.

12           And they think they're still working on the  
13 revisions, they've spent at least two years. And that  
14 subcommittee represented local enforcing agencies and  
15 industry, as well as Lisa Meline was participating in  
16 that effort, as well.

17           And there should be one more line at the bottom.  
18 In 2012, my branch received support from Department of  
19 Water Resources management to begin updating the GHEW  
20 standards and that's the project that we're working on  
21 currently.

22           One of the reasons that we did get approval to  
23 begin updating the standards and finalizing them,  
24 eventually, was because of public interest.

25           So, these are the well standards documents, I

1 didn't really talk about them in detail. The two on the  
2 left cover water wells, cathodic protection and  
3 monitoring wells. The one on the right is the draft  
4 standard and that's what we're updating in this project,  
5 only that document.

6           The water code outlines the process for  
7 implementing well standards as follows: DWR develops the  
8 standards and recommends those to the State Water  
9 Resources Control Board.

10           The State Water Resources Control Board is  
11 responsible for adopting a model well ordinance based on  
12 those standards.

13           Cities, counties and/or water agencies,  
14 depending on who has jurisdiction in a particular area,  
15 then are required to adopt a local well ordinance.

16           And then a local enforcing agency administers  
17 and enforces that. That would be the -- sometimes  
18 they're called a well permitting agency.

19           If there's no local well ordinance adopted, then  
20 the model well ordinance goes into effect in a  
21 particular area.

22           And this is the process that applies to all of  
23 the four types of wells that we draft standards for or  
24 prepare standards for.

25           Why is groundwater important? Why is it

1 important to protect groundwater in California? It may  
2 seem obvious, but some of these statistics emphasize the  
3 importance of groundwater.

4 It provides 25 to 40 percent of the water supply  
5 in California during a normal year and even more in a  
6 drought.

7 About 43 percent of Californians rely on  
8 groundwater as a drinking water source. It's widely  
9 available throughout the State. In many areas there's  
10 no alternative.

11 And, generally, it's good quality when it comes  
12 out of the ground and requires little treatment. And it  
13 is a limited resource.

14 In general, well standards protect groundwater  
15 quality as follows: Every boring into the ground is a  
16 potential conduit for contamination. Remediation is  
17 expensive and can take a long time, hundreds to  
18 thousands of years, if not forever.

19 Standards are written to prevent wells from  
20 becoming conduits for contamination and they are a  
21 minimum for construction and destruction of wells to  
22 protect groundwater quality.

23 So, our project scope for updating the GHEW  
24 standards are pretty clearly defined by the California  
25 Water Code, and as follows: We're developing minimum

1 standards for construction, maintenance, abandonment and  
2 destruction for the purpose of protecting groundwater  
3 quality.

4           The water code defines a GHEW, a geothermal heat  
5 exchange well. I've highlighted the key points in the  
6 definition here, but I'll just read the whole thing  
7 because I'm --

8           "As used in this chapter means any uncased,  
9 artificial excavation by any method that uses the heat  
10 exchange capacity of the earth for heating and cooling,  
11 in which excavation the ambient ground temperature is 86  
12 degrees Fahrenheit or less, in which excavation uses a  
13 closed loop fluid system to prevent the discharge or  
14 escape of its fluids into surrounding aquifers or other  
15 geologic formations. Geothermal heat exchange wells  
16 include ground source heat pump wells."

17           So, it does not include hot geothermal, as was  
18 discussed before. Open loop systems are not included.  
19 They meet the definition of a water well, so water well  
20 standards apply. And the standards don't cover surface  
21 water systems.

22           So, this is just a simple schematic of a closed  
23 loop system.

24           So, just to summarize, in a GHEW fluid is  
25 circulated in a closed loop of pipe that transfers heat

1 from or to the ground, taking advantage of the earth's  
2 relatively constant temperature.

3           And there are two basic types of ground source  
4 systems, vertical and horizontal.

5           Vertical can be subdivided if their series are  
6 parallel, although I don't think that's that common,  
7 necessarily.

8           And then horizontal can be further defined by  
9 how they're constructed. For instance, trench,  
10 excavation, or horizontal directional drilling. That's  
11 what the HDD stands for.

12           So, the ways in which -- just to illustrate a  
13 little further the ways in which standards protect  
14 groundwater quality for GHEW, proper grouting and  
15 sealing between the piping and the borehole can prevent  
16 contaminated water from entering the aquifer either from  
17 the surface or between aquifers.

18           And I just have a rough sketch here of how  
19 that -- so you can visualize how that might occur. So,  
20 if there's -- if you have an unsealed borehole, God  
21 forbid, that on the left there's a borehole that's a  
22 vertical loop, that's in construction, so there's no  
23 fill, and the blue is meant to illustrate contamination  
24 entering down into the aquifer through the opening  
25 there, or in between these two aquifers.

1           And then on the right, the contaminated water is  
2 entering through the fill and seeping down into the  
3 borehole, which is not sealed.

4           And so, then in this illustration it illustrates  
5 no seal -- oh, I'm sorry. So, this is contamination  
6 from an adjacent aquifer.

7           And then this third image is just showing if you  
8 have a seal, but it's not effective, it's cracked and  
9 there are voids, it can allow the same types of  
10 contamination.

11           So, other ways that standards can protect  
12 groundwater quality: Proper construction and destruction  
13 can prevent the release of heat transfer fluid into the  
14 aquifer.

15           And then identification in the field can prevent  
16 damage to loops or fluid leaks -- which could lead to  
17 fluid leaks.

18           And adequate setbacks can minimize impacts.

19           This slide is to help you kind of visualize  
20 what's in the standards. This is not the table of  
21 contents, but it's some of the elements that are covered  
22 in the standard so that you can start thinking about,  
23 you know, how does this affect me and then, you know,  
24 based on your experience what can you offer as input to  
25 us, as we're developing standards.

1           So, location, setbacks, driller qualifications,  
2 that's pretty much set out by the code.

3           Reporting requirements, similarly.

4           Definitions; borehole diameter, installation,  
5 sealing materials, circulating pipe, loop material and  
6 connections or adjoining, loop fluids, pressure testing,  
7 field identification, maintenance and destruction.

8           Limitations of the standards; DWR standards  
9 don't ensure proper function, sizing or efficiency of a  
10 GHEW system. And they are not a manual for GHEW  
11 construction or destruction. They're very much focused  
12 on standards to protect groundwater quality.

13           So, to date, just to report a little bit on our  
14 progress, what's not shown on this slide is we did an  
15 initial outreach effort where we tried to contact as  
16 many stakeholders as possible through industry  
17 organizations, permitting agencies, anyone we felt would  
18 potentially be interested.

19           And if you're a licensed driller in the State,  
20 you might have received a postcard recently because  
21 there was a glitch when we tried to use the California  
22 State Licensing Board's list servers. And, apparently,  
23 the announcement didn't go out, so we went back to  
24 paper.

25           So, in any case, we've done extensive outreach

1 to let people know we're doing this project.

2           And then we had an initial stakeholder meeting  
3 at the end of November. Since then, we've kind of had  
4 our heads down doing research and preparing revisions,  
5 the internal draft version of the standards.

6           We completed a State survey, which was very  
7 rigorous. I have some notes here. It's been very  
8 helpful to me, as I prepare the revisions to the  
9 California standards.

10           And this is a tradition, for lack of a better  
11 word, and when the well standards have been updated in  
12 the past the DWR surveys what are other states doing,  
13 and what are counties doing, in addition to looking at  
14 other literature. And it helps us be thorough,  
15 reasonable, and practical and leverage the experience  
16 and expertise of a large body of people working in this  
17 industry.

18           So, I don't know if you're interested, it's a  
19 very large spread sheet that I built, and we looked at  
20 22 elements, all 50 states, and just for GHEWs. And I  
21 found that 37 of the 50 states had standards or  
22 guidelines specific to GHEWs.

23           And I guess I can skip some of these other --  
24 this other information. But it's been a very helpful  
25 thing to do.

1           We also have surveyed counties, and we did an  
2 initial just questionnaire, via e-mail, through the  
3 WWTAC, of local enforcing agencies and what standards  
4 are they using. And we didn't get a huge response, so  
5 we are following that up with phone calls, and we're  
6 about halfway done.

7           To date, we have had responses from 32 of 76  
8 local enforcing agencies around the State.

9           Of those 32, 21 are using the 1999 draft  
10 standards, four are using their own, something other  
11 than the 1999 draft, and seven have not had a need so  
12 they're not using anything.

13           So, we will continue to do that survey. And of  
14 the four that are using their own, we will review them  
15 as we've reviewed the other states' standards.

16           We've also done extensive literature review and  
17 interviews with industry folks, and one of the authors  
18 of the Nebraska Grout Study. We've looked at the  
19 standards in depth over, and over again. Industry spec  
20 sheets, PPI, the Plastics Pipe Institute Guidelines and  
21 Technical Reports, ASTM standards, and other national  
22 and international codes and standards, and research  
23 papers.

24           As we compose the draft standards we do this --  
25 we do an engineering evaluation, they're kind of tied

1 together, and meet and hash out some of the details.

2           So, what's next, so we'll finish composing the  
3 draft and then the internal draft will be reviewed by an  
4 internal TAC for -- I don't know, it doesn't have a  
5 name, yet, but we'll have a group of engineers and hydro  
6 geologists review this internal draft and before it goes  
7 out to release to the public, as a public draft.

8           And then we plan to have a 30-day minimum  
9 comment period and two public workshops during that  
10 comment period to kind of talk to you about your  
11 reactions and explain our thinking.

12           So, and then, finally, it will be finalized this  
13 time around and we will present it to the State Water  
14 Resources Control Board, and we anticipate we'll do that  
15 this summer, the summer of 2013.

16           MR. LOYER: Thank you, Julie.

17           That brings us to the question and answer  
18 portion of this. And I think we want to do -- I think,  
19 Julie, you have to -- you said you have to go. So, do  
20 we have any questions for Julie right now?

21           MR. SPLITT: It's Pat Splitt from App-Tech,  
22 again, a couple of questions. Is there any depth  
23 limitation to where these regulations come in? Do I  
24 have to go down a certain depth before we have to go  
25 through and get it approved, and sealed, and --

1 MS. HAAS: Well, no, there's no depth  
2 regulation. But, first of all, we're -- there's no  
3 requirements at this time related to the standards that  
4 we're drafting. And I can't remember what's in the 1999  
5 draft.

6 But, basically, if you have a current project,  
7 you have to work with your local enforcing agency to  
8 make sure that you're following their requirements.  
9 Does that make sense?

10 But for the draft that I'm working on right now,  
11 no, there's no depth limitation.

12 MR. SPLITT: The reason I ask is that there is  
13 some other systems that I work with, heat recovery  
14 ventilators, that now incorporate what used to be ground  
15 loops, earth tubes, where there are tubes sine wing  
16 around a lot and then opening up to the atmosphere,  
17 which is --

18 MS. HAAS: You mean they're natural formations,  
19 is that what --

20 MR. SPLITT: No, no, they're trenches and they  
21 put tubing in there, and they run -- they bring the  
22 outside air -- instead of bringing the outside air  
23 directly into the house they bring it from this opening  
24 in the yard, down through these tubes, and underground,  
25 and then into the house.

1           And there's another system that, instead of  
2 having air, they have a loop, a brine loop which is, for  
3 all intents and purposes, exactly the same as one of  
4 these bores, but it's just to transfer heat from the  
5 earth that then gets into the incoming air. But it's a  
6 brine loop so they don't have to worry about --

7           MS. HAAS: Is it in a conduit, I mean --

8           MR. SPLITT: There are all different types.

9           MR. DOCKERY: This is Randy Dockery with Gregg  
10 Drilling.

11           Your depth, minimum depth requirements are  
12 usually set by your local enforcement agency and it  
13 varies. But, generally, it's anything deeper than five  
14 feet. A few of them like to go a little bit less, but  
15 anything usually deeper than five feet is going to have  
16 to be permitted.

17           MR. SPLITT: So, but will that be the case once  
18 your regulation comes out? Will they still have an  
19 option to modify it or you're just going to say --

20           MS. HAAS: They have an option.

21           MR. SPLITT: Okay.

22           MS. HAAS: Yeah, they have an option to modify.

23           MR. SPLITT: Okay, that's it.

24           MS. HAAS: Okay. And I refer back to the  
25 definition of the GHEWS often, and I encourage you to

1 look at that because that's what we're following as we  
2 prepare the standards. And I don't know, I can bring it  
3 up again.

4 MR. PENNING: My name is Kent Penning. I'm a  
5 contractor and wholesale distributor of geothermal  
6 stuff.

7 In your well drilling thing, can you please  
8 include in there some mention of direct expansion  
9 systems, where they put copper tubing in the ground with  
10 refrigerant, because that's kind of an oddball  
11 application and a lot of people don't know what to do  
12 about it.

13 MS. HAAS: Thank you for bringing that up. It's  
14 something that I'm working on.

15 MR. PENNING: Anyway, that's my comment.

16 MS. HAAS: I'm working on it, thank you.

17 MR. LOYER: Is there any other questions for  
18 Julie?

19 All right, thanks, Julie.

20 MS. HAAS: Thank you very much.

21 MR. LOYER: Any questions for Rob? I think  
22 there should probably be at least -- at least one  
23 person, yeah.

24 MR. SPLITT: Or if he just wants to stick  
25 around, we can do that in the next session, as well.

1           MR. LOYER: Thank you. You want to do that?  
2 Okay, sure, yeah, because we are running a little over,  
3 yeah.

4           In that case, I think why don't we go ahead and  
5 start the final panel. Are you ready for that?

6           Okay. Now, you notice I've arranged the desk  
7 here in a large U shape. All the microphones are  
8 active. So, if you would like to find a space, Paul,  
9 Shawn Melton, Sean Dillon, Marc, Randy Dockery, and Lisa  
10 if she's still here. Yeah, are you still able?

11           (Round Table participants assemble)

12           MR. LOYER: And if we have a -- I know there  
13 were a couple of other people that were maybe going to  
14 be here, maybe not. If we need more chairs, we have a  
15 microphone all the way on the other side, if we need  
16 that. There is fresh water.

17           MR. HENRY: Dennis Murphy is on the panel, as  
18 well, the Project Negatherm Principal Investigator.

19           MR. LOYER: All right, Dennis, yeah. Make your  
20 way up here, if you won't mind, sir.

21           Now, I think we were going to go over some of  
22 the topic issues here but, Phil, do you want to just  
23 throw it open to the public to ask questions and make  
24 comments to the panel?

25           MR. HENRY: Yeah, I think so, maybe that would

1 be a good place to start.

2 MR. LOYER: Yeah.

3 MR. HENRY: Give folks in the audience a chance  
4 to weigh in.

5 MR. LOYER: I think so, yeah, particularly given  
6 the last presentations.

7 So, if you'd like to make your questions and  
8 comments, we have the whole panel here, yeah, and if  
9 anybody else has any comments?

10 All right, I think -- yeah, or anything that we  
11 have talked about today.

12 MR. SPLITT: Okay, it's Pat Splitt from App-  
13 Tech, again. I've got a couple of comments, two real  
14 short ones, so I'll just get those out of the way.

15 Just in my neck of the woods I attempt once in a  
16 while to do a ground source heat pump system, but I'm  
17 right on the coast in Santa Cruz and we have no cooling  
18 load, so it's a lot harder to justify.

19 If I get a customer just over the Santa Cruz  
20 Mountains, in Gilroy or Morgan Hill, then there's more  
21 of a chance of having to do that. I have two customers  
22 right now that are potential, but they're holding off  
23 because I can't figure out how to qualify them for a New  
24 Solar Homes Partnership Rebate.

25 So, one thing that's come up in the past for me,

1 that I didn't hear the group mention, is the California  
2 Coastal Zone. And my neck of the words are right on the  
3 coast and as soon as they hear you're boring down, they  
4 want to get involved.

5 And as soon as a client hears the California  
6 Coastal Commission wants to get involved that's the end  
7 of the system. So, that's another agency that I think,  
8 if it's not on your list, you want to get on your list.

9 MR. LOYER: Yeah, the actually -- I think at one  
10 point I had taken a look at the possibilities of how  
11 many different agencies could possibly weigh in with a  
12 permit, or a requirement, or reporting, or an inspection  
13 and I came up with a God awful list.

14 And, yeah, the Coastal Zone, the Coastal  
15 Commission, yeah, that is going to be very problematic.

16 I think the key solution to that is just, from  
17 my basic experience in working with local ordinance and  
18 outreach, is to go to local jurisdictions and talk to  
19 the actual permitting agencies, and get them on board,  
20 and get them to understand what the product is, and what  
21 their responsibilities should be, and how they can use  
22 their own authority to hand out a permit.

23 Because most of the time I'm finding that  
24 there's resistance because the organization, itself,  
25 does not understand the technology and does not

1 understand how they can possibly permit such a thing.

2           So, I think education and outreach is the real  
3 key. It may be a little ways off, but I think that's  
4 one of the things that can be folded into the policy  
5 recommendations that we do make to the Energy Commission  
6 and the Commissioners.

7           MR. SPLITT: And the other quick comment is  
8 there was earlier mention of maybe we need some more  
9 data bases in California. So, one I would like to see  
10 is for the few jobs I work in, in my area, I have a well  
11 driller that I work with that's very experienced and has  
12 a lot of information about zillions of wells that he's  
13 drilled in our area. So, he has a lot of information on  
14 the ground conditions.

15           But once I get somebody out of my area I don't  
16 have a clue, and it would be nice if there was some sort  
17 of data depository for -- that well drillers could  
18 upload their well information, so we'd build up a  
19 database over time of what the ground conditions were,  
20 that would easily accessible and understandable.

21           MS. MELINE: In the State of California, if you  
22 have a water well, it is not public knowledge.

23           But if you have a borehole or a thermal  
24 connectivity -- well, not a thermal connectivity test,  
25 but if you drill a borehole and there's a drill log

1 associated with that, you can get that from the county.

2 MR. SPLITT: Well, okay, but there's a lot more  
3 well information and it would be nice if, you know --

4 MS. MELINE: But the way that the water code and  
5 the State of California currently deals with that --

6 MR. SPLITT: Well, we just talked to somebody  
7 that's working on the water codes, right.

8 MS. MELINE: Well, I know, but I'm just letting  
9 you know that's the way the law reads currently, that's  
10 why their --

11 MR. SPLITT: But I'm just saying -- I just said  
12 that's an idea and it would be nice if we had that.

13 MS. MELINE: Yeah, and I understand that. It is  
14 a source of frustration because California is different  
15 than a lot of other states where that information is  
16 made public through a database or some way. So, I know  
17 that the California Groundwater Association and --  
18 Randy, you probably know more about this than I do. But  
19 I know that they have been really pushing to try to  
20 change that and so far have been unsuccessful.

21 MR. SPLITT: Okay.

22 MR. KAVANAUGH: So, the State of Tennessee has  
23 got an online -- or it's actually put in place by the  
24 Tennessee Valley Authority. Their way of promoting,  
25 helping promote the technology was to, in commercial

1 applications, subsidize the thermal test of the ground.  
2 And so, as a result of that, they've put all their test  
3 bores, which includes the thermal conductivity, the  
4 temperature, and the thermal diffusivity online. So, at  
5 some point, you know, you're doing quite a few tests in  
6 the State to do the designs, the proper designs on the  
7 larger systems, so if there's some way you could roll  
8 that in through CaliforniaGeo and put it online -- you  
9 just come up and it's got lots of little dots of all the  
10 places where you've done thermal conductivity testing  
11 and you click on it and you can see the full report.

12 MR. SPLITT: Yeah, okay, that would be good for  
13 me because I do very few of them so I, you know, have a  
14 hard time remembering what I did the last time.

15 MR. KAVANAUGH: Yeah, we've got to catch up to  
16 Tennessee.

17 MR. HUDLER: Yeah, also one comment, yeah, from  
18 a past life, the USGS groundwater has an extensive  
19 listing of wells for the State of California. That  
20 database may be acceptable, but having worked on it I  
21 can tell you the information is highly suspicious.

22 (Laughter)

23 MR. DOCKERY: There's also the Department of  
24 Oil, Gas and Geothermal keeps a very good database and  
25 you'd be surprised at the number of oil and gas wells

1 that have been drilled in the last 150 years, the DOM  
2 site.

3 MR. SPLITT: Okay. Well, it might be nice,  
4 then, if the Geo organization put a list of those on the  
5 website so you could go to one place and at least get a  
6 list of where to look.

7 MR. MURPHY: One other suggestion, shout out to  
8 Gregg Drilling, actually on their website they document  
9 their work, and so that's something that's also worth  
10 checking out.

11 MR. DOCKERY: It's more just for water levels.

12 MR. MURPHY: Yeah.

13 MR. SPLITT: Okay, I wanted to just throw that  
14 out.

15 So, my main concern is back to, since I do a lot  
16 of residential energy compliance and residential design,  
17 is we can't really now input COP in EERS, even though  
18 for years and years people have been asking for it.

19 And I'm also working on air to water heat pumps,  
20 which have the same problem, they have COPs and EERs.

21 So, my concept was that we could, at least in  
22 the interim, just come up with a simple way of modifying  
23 the residential program so that we can input COPs and  
24 EERs. And if one COP is from an air to water, and  
25 another is from a ground source maybe there's, you know,

1 little things that aren't exactly coincident, but it's  
2 better than nothing, and it will at least get people to  
3 actually legally put in these systems. I mean, we're  
4 all putting them in anyway. Put them in legally and  
5 actually have a number, then, that people can start  
6 comparing and you can do your energy analysis, you can  
7 show that you're 15 percent better than Title 24, you  
8 can get a rebate. It would be simple and we could just  
9 look at it, collect data and see how this goes for a  
10 couple of years, and then a lot of people are going to  
11 decide, well, this should be tweaked and that should be  
12 tweaked, and we could fix it later.

13           But I think we ought to start by doing something  
14 simple just to get it going so that -- I know it's not  
15 hard to input those numbers. If you start worrying  
16 about the fact that, well, we've got this ground loop  
17 and geo systems that we don't have any air to water, but  
18 the air temperatures vary more in the air to water, you  
19 know, in my mind I'm just going to say, well, all these  
20 pluses and minuses just for the initial jot they pretty  
21 much cancel out.

22           On average, your systems are going to look  
23 better because your EERs and COPs are better than the  
24 air to water, so I wouldn't think you'd bother -- mind  
25 it so much.

1           But I'd like to get something just so I can  
2 actually have a little confidence that -- you know,  
3 right now what happens is I can go to a building  
4 department and I can convince them that it's okay to put  
5 this system in and that it's efficient, and so I get a  
6 building permit.

7           If that's all my client's concerned about, we're  
8 done. But these are super-efficient homes where he's  
9 also put in PV panels, he wants awards, he wants a  
10 rebate from the utility, and they want to have  
11 something, you know, that's official that says what this  
12 efficiency is.

13           And when we get the Title 24 report that says  
14 it's 15 percent better than Title 24 can we depend on  
15 it, or can you at least compare these from different  
16 calculations?

17           Right now, the way I justify my equipment that's  
18 going on, and the way anybody else does, you come up  
19 with different numbers. You know, you all came up with  
20 some scheme that makes sense in your mind and it made  
21 sense in the building official's mind, so for that  
22 instance it worked, but for the next guy you might have  
23 to come up with something different.

24           It would at least be a good step ahead if we  
25 could just start with some standard calculation and then

1 go from there.

2           And the other thing that is important is in  
3 residential all the systems that I put in, in my area, I  
4 don't do cooling hardly at all, but every one of them is  
5 also domestic hot water.

6           And in residential there's a separate  
7 calculation if you have what's called a combined  
8 hydronic system. So, that's another calculation that  
9 you also have to have, be able to take the input of COP  
10 and EER. If you don't do that -- if you do that, you  
11 get an additional boost because you get a benefit of  
12 having one system doing two jobs.

13           So, I've been trying for years to get this and I  
14 really don't want to wait until 2015 or something  
15 because I'm putting in systems now. And in my mind, you  
16 know, they work fine, and they do work fine. People are  
17 living there, their houses are heated. It just is very  
18 frustrating.

19           So, maybe there's some way. I don't know if you  
20 guys would want to think about proposing something like  
21 that. I guess Rob was sort of suggesting that they'd do  
22 it for 2,000 bucks.

23           MR. HENRY: Yeah, so if I may? Can I address  
24 that?

25           MR. LOYER: Sure.

1           MR. HENRY: So, essentially -- essentially, if I  
2 understand you right, Pat, there would be some other  
3 technologies that would potentially benefit from  
4 addressing the issues that Rob was speaking to earlier.  
5 And so, I think, you know, you and I have had this  
6 conversation.

7           MR. SPLITT: Uh-hum.

8           MR. HENRY: I'm glad you're here vocalizing it,  
9 but at the risk of sounding too abrupt, I'd like to get  
10 his redirected back to the GHP side for a little bit,  
11 because that really is the focus of the workshop.

12           But I do want to acknowledge that there are  
13 industries with similar issues and we all can  
14 potentially benefit from it.

15           And the conversation about Title 24 and ACM is  
16 one -- is going to be ongoing, and lengthy, and I think  
17 we'll all looking forward to that.

18           MR. SPLITT: Okay, I'm all for just -- it's just  
19 I didn't want to reinvent the wheel and I think it would  
20 be exactly the same calculation on either side.

21           But one other thing to keep in mind, if we're  
22 just talking about doing ground source heat pumps and  
23 doing combined hydronic is there are two methods that  
24 you heat hot water. You can directly heat hot water if  
25 you're using a lot of hot water, but here's another

1 system where in the cooling mode you do desuperheater to  
2 also heat hot water. And those have different  
3 efficiencies. And so, when you're talking about heating  
4 hot water you may have to think about those two  
5 different ways that you do it.

6 And in some areas there would be a lot of  
7 desuperheating, in my area there would be none. So, I  
8 don't know, it's just another variable that you have to  
9 define.

10 MR. HENRY: Were there any more questions from  
11 the group?

12 MR. LOYER: Just step right up to the microphone  
13 and make sure you state your name.

14 MR. PENNING: Hello, my name is Kent Penning,  
15 again. I wear three different hats. I'm a contractor  
16 down in the Santa Clara Valley. Also, I'm a distributor  
17 of geothermal equipment. I'm also an instructor at a  
18 trade school down in San Jose for people that put in  
19 these kind of systems.

20 I just had a couple of quick points that I  
21 wanted to make. To the gentleman with the CEC, thank  
22 you for foregoing the HERS requirements on these type of  
23 systems. I think that's a great incentive for making  
24 these systems more popular and more friendly to the  
25 contractor and the installation community. Simpler is

1 better. Less paperwork is better.

2 The other comment I want to make is the CEC, my  
3 understanding is they hold the leash of the CPUC, which  
4 tells PG&E what to do.

5 (Laughter)

6 MR. PENNING: So, anyway, I would like to see  
7 PG&E have more flexibility for offering things like Paul  
8 was talking about, on-bill financing for the loops and,  
9 you know, geothermal systems.

10 We have also been doing some -- we're calling  
11 them geothermal systems, but we're connecting them to  
12 the HVAC systems, to pools.

13 UC Davis did a study, and the Santa Clara Valley  
14 is a real good place for that. Anyway, they've been  
15 working real well and I'd like those to be brought up as  
16 being classified and categorized as the same thing as a  
17 geothermal.

18 Another option, people that are primary  
19 candidates for these geothermal systems are the propane  
20 people out in the rural areas. And my understanding is  
21 oftentimes they're left out of the rebate programs and  
22 the incentives, and that's a great way to cut down on  
23 the CO2 emissions is by letting those folks enjoy some  
24 of the rebates and some of the benefits. Thank you.

25 MR. LOYER: Thank you. Would anybody else like

1 to make some comments or ask some questions?

2           If I could ask the panel to basically turn to  
3 each other and, essentially, you know, considering some  
4 of the barriers that we've been talking about, I'd like  
5 to just ask the basic question. We've heard some  
6 solutions to financing for the loops. We've heard some  
7 solutions to lowering initial costs.

8           And we've not heard that many solutions to  
9 removing some of the policy barriers that we see the  
10 State sort of, for lack of a better term, accidentally  
11 engaging in.

12           And I think what I'd like to just ask is, you  
13 know, does anybody have a good solution for the State to  
14 take a look at their policies and make some policy  
15 recommendations?

16           And I ask this, while at the same time saying we  
17 are going -- this is not the end of the conversation.  
18 Today is not the last word that will be said.

19           We are going to have a working group, which I  
20 encourage all of you in the audience, online, and the  
21 members here of this board to engage in. And we will be  
22 talking about the policies that we will be recommending  
23 to the Commissioners going forward.

24           But are there any ideas on the table, now, that  
25 we want to discuss?

1           MR. DILLON: I don't have to push this, do I?  
2 Push the button, no.

3           MR. LOYER: No, the green light is good.

4           MR. DILLON: Sean Dillon with WaterFurnace.  
5 Thank you, everybody, for coming. I want to start off  
6 by saying that one of the biggest hurdles I see, the  
7 additional cost with these systems, especially in a  
8 residential platform, is the ground loop.

9           The Federal tax credit is 30 percent, 30 percent  
10 of the cost of the system. And my understanding, or at  
11 least my belief, is that's supposed to take away some of  
12 the pain of that outdoor heat exchanger.

13           And in California, and I cover the west, much  
14 like Paul and Shawn covers much of the country, there  
15 are not as many hurdles with the ground loop as there  
16 are in the State of California.

17           The additional cost is in the ground loop, it's  
18 in the heat exchanger, typically.

19           If you were to take an air source heat pump and  
20 a furnace, providing both heating and cooling, versus  
21 one ground source heat pump which provides heating and  
22 cooling, that one ground source heat pump lasts twice as  
23 long, on average, as those two other pieces of  
24 equipment. It's indoors, it's protected from the  
25 elements, it's protected from kids with bats, and

1 lawnmower trimmings, and all of the other things, so you  
2 get twice the life.

3 But those costs are similar between those two  
4 pieces of equipment and one ground source heat pump  
5 providing heating and cooling, and in addition to hot  
6 water.

7 And one clarification, sir, in heating mode you  
8 can get some desuperheater, you can get additional  
9 domestic hot water. It does not have to just -- just be  
10 in the cooling.

11 But I think I see that as one of the biggest  
12 hurdles in the State is the ground loop heat exchanger,  
13 and the cost associated with that, as well as all of the  
14 regulations.

15 And I'm not saying that they're not good  
16 regulations because they're all meant to secure, as well  
17 as protect the resources in California and the water,  
18 but at the same time there's an over-protection that is  
19 inhibitive to these systems and all the benefits that  
20 these systems can give both the homeowners, consumers,  
21 as well as commercial applications, and utilities.

22 MS. MELINE: So, I think it would be helpful,  
23 Sean, if maybe, Randy, you could explain why is it that,  
24 for instance, in Texas you can get ground loop at \$6.00  
25 a foot and why it's like three times that here. It's

1 not because you're making a ton of money, right?

2 MR. DOCKERY: No.

3 MS. MELINE: So, can you explain to us all what  
4 those additional costs are?

5 MR. DOCKERY: It's, you know, the old say,  
6 "death by a thousand cuts." There's a whole myriad of  
7 regulations that you have to comply with.

8 I guess, kind of where to start, the permitting  
9 process, itself, I think that was covered a little bit,  
10 is kind of hodgepodge. There's no state standard for  
11 it. Some counties have adopted, some counties don't  
12 even know what a heat loop is.

13 Pricing is anywhere from \$20 or \$30 a loop to  
14 upwards of \$1,000 per loop.

15 The production drilling here, in many places  
16 because the geology isn't -- you're not capable of doing  
17 multiple holes in a day.

18 In Texas, a lot of places there, Oklahoma, up  
19 into Kansas, you know, those guys can do four or five,  
20 sometimes six loops a day. That drives your per-foot  
21 costs way down.

22 In California, in most places you're going to  
23 get one, so your fixed expenses are fixed and it's  
24 divided over less footage.

25 In California we are required to have total

1 containment on our drill cuttings and spoils, we're not  
2 allowed to discharge anything onto the ground. That is  
3 a production inhibitor, as well as a cost. It adds  
4 quite a bit of cost to the project.

5           You know, the fuel costs are pretty much the  
6 same across the country. I mean, that's one of your big  
7 items, you know, you can easily burn a couple a hundred  
8 gallons of fuel a day.

9           And then, again, if you're drilling, and you're  
10 running at full throttle, and you're drilling a thousand  
11 foot a day, your fuel cost per foot isn't much less than  
12 if you're drilling only 300-foot a day. So, you know,  
13 that's a big one at four bucks a gallon.

14           And, let's see, then the disposal on the  
15 cuttings.

16           MS. MELINE: What about labor costs?

17           MR. DOCKERY: Labor costs, well, California does  
18 have, especially on State jobs, the prevailing wage is  
19 quite high. But average wages are also much higher than  
20 other parts of the country.

21           But, you know, you've got to pay the guys a wage  
22 they can live on. So, you know, I don't consider labor  
23 to be too far out of line. And, actually, in many  
24 places in the country, you know, operators are paid  
25 pretty much the same they are here. You know, the guys

1 are paid well, but it's not considered a burden.

2 But back to what I was saying, disposal costs,  
3 you know, because of the total containment we're not  
4 allowed to discharge everything. It has to be contained  
5 and sent to the landfill.

6 Generally, most of your drilling methods here  
7 involve drilling with mud rotary, which the landfills  
8 won't accept liquids. And then the drill cuttings,  
9 themselves, are pretty wet so those have to be  
10 solidified, you know, either on site or at the landfill,  
11 and that is a pretty expensive proposition.

12 I know you used to be able to dig pits and bury  
13 them on site, but I know that -- I haven't seen that  
14 done in a number of years.

15 MR. DILLON: And, Randy, what's done in other  
16 areas, other states, other -- as far as with the drill  
17 cuttings.

18 MR. DOCKERY: Well, you know, I'd kind of like  
19 to sell the total containment because generally, in  
20 other states, these guys will build a berm around the  
21 entire loop field and get in there, and everything goes  
22 on the ground, but it's contained within the field.

23 And after it dries up it's either incorporated  
24 into fill or it's scooped up and hauled off.

25 But here, you know, generally, we're not allowed

1 to discharge anything on the ground.

2 MR. HENRY: So, then it sounds like from the  
3 driller's perspective the biggest -- the largest piece  
4 that's different from the rest of the country is the  
5 production rate due to the geology. I mean, this is --  
6 it's not the same as in Texas, right, so it's the  
7 production rate?

8 MR. DOCKERY: The production rate, yeah, the  
9 production rate.

10 MR. MURPHY: So, unless there's a motion to  
11 change the geology of California --

12 MR. DOCKERY: Yeah. I mean, there are --

13 MR. MURPHY: I'd like to just focus on one  
14 thing. I mean that the 73, 76, 78, I don't know if you  
15 include the Coastal Commission, 79 permitting  
16 authorities in California.

17 You know, the Balkans were created over hundreds  
18 of years of history and, you know, religious  
19 differences, and cultural differences. But we've almost  
20 willingly created a Balkans when it comes to this issue,  
21 and in terms of the permitting and the understanding.

22 In terms of -- I'll try to introduce a new  
23 concept, "state leadership." Consider a future where we  
24 had one agency -- I mean, for one thing, we have to  
25 separate boreholes from water wells.

1           I mean, you know, fundamental kind of thing. I  
2 mean, it sounds like a simple idea but, apparently, it's  
3 been kicking around since 1999.

4           But in terms of if there was one agency, or at  
5 least a kind of one clear directive that is actually  
6 understood and is out of draft mode, then -- and there  
7 was, perhaps, one pricing element. I mean, some states  
8 do this. Idaho does this. And, you know, it makes -- I  
9 would think it would make doing business and actually  
10 scaling geo a little bit easier.

11           You know, we can't do anything about the  
12 geology. And it's always going to be more expensive to  
13 do work in California. I mean, you know, the sanctity  
14 of groundwater is, you know -- well, there's a reason.  
15 And, you know, we're not going to be able to do the  
16 berms around the entire field. I mean, not in your  
17 dreams. And, you know, the wages and everything else.

18           But in terms of administrative, I mean, this is  
19 something -- I mean, we're talking on and off about CEQA  
20 reform and lessening regulations. I mean, at a very  
21 high level, you know, lessening regulation. You hear  
22 that a lot from the Governor, you hear it from Senator  
23 Steinberg about needless regulations.

24           Well, I would think this would -- you know,  
25 having 78 permitting authorities on something like this

1 would seem to me to be a red flag in front of those  
2 bulls. So, anyway, just wanted to throw that out.

3 MR. DOCKERY: Yeah, to kind of add, I'm not  
4 originally from California. I moved here in 2000. I  
5 grew up in the southeast and worked, and I've been in  
6 the drilling industry for 34 years.

7 Now, I've drilled in about 38 states, including  
8 California. And, yeah, our regulatory environment is --  
9 just to get a job started is incredibly difficult. You  
10 know, many states require the individual operator to be  
11 licensed. Not as in California, they require one person  
12 within the company to be licensed, and as long as you  
13 can trust that person to go out, they can drill.

14 And, you know, there's some states where you  
15 file a notice with the state, you know, just send a  
16 little card in and, you know, we're going to be drilling  
17 here, and you go do it. And someone from the State may  
18 or may not show up.

19 I've worked in states where they don't do  
20 permits or anything, you do completion reports when  
21 you're done and send them in. But they have a staff of  
22 people that basically drive around looking for a mast  
23 sticking up in the air.

24 And, you know, they find a drill rig, they'll  
25 come up, identify themselves and you have to show them

1 your license in just one of the states that require  
2 individual licenses for operators.

3 If that person can't produce that license, they  
4 can actually take them to jail, and then they can also  
5 go back and do forensic work on wells and verify that,  
6 you know, grouting and all is done.

7 But there's a lot of different ways of doing it.

8 MR. HOELLWARTH: Joe, timing wise, are we  
9 planning to end at 5:00 or can we go beyond 5:00?

10 MR. LOYER: We really should end at 5:00, but we  
11 can go -- I mean, you know, ten minutes or so beyond  
12 would be fine.

13 MR. HOELLWARTH: If people want to stay. Okay.  
14 Before we -- it's 15 minutes before 5:00, before we all  
15 get into other digressions, the purpose for the workshop  
16 is to kick off activities toward developing policies  
17 that can go into our State-required policy manual for  
18 energy, every two years, update every year.

19 From Dennis's comment and the discussion here,  
20 it sounds like most of the policy discussion is going to  
21 be around regulations. Is that the only policy item  
22 that we want to address in here, and I'd like to take  
23 some comments on that.

24 And then I've listened to the barriers that were  
25 brought up earlier today and I'd like to kind of touch

1 on each one to say, you know, which are the things that  
2 are actions that we should be moving forward toward this  
3 idea of developing policies for the State?

4 Steve?

5 MR. KAVANAUGH: Were you here for my  
6 presentation?

7 MR. HOELLWARTH: Yes, I was.

8 MR. KAVANAUGH: Okay. And I stand by my first  
9 statement on my conclusion, that HSPF, SEER, and KW per  
10 ton are marketing tools. They are not a good  
11 engineer's, in my opinion, and I think I have a little  
12 bit of experience in the area, should not be using SEER  
13 and HSPF, and KW per ton.

14 So, rather than making these folks pay 2,000  
15 bucks and wait three years, I would strongly suggest you  
16 look real hard at those -- what those things really are,  
17 how bogus they really are, and go to something else.

18 It was said that this is mandated by the Federal  
19 Government, but the Federal Government also requires you  
20 to test, but necessarily report, COP at 17, COP at 47,  
21 EER at 82. No one reports EER at 82, but there is a  
22 test for it, Test B. Test A is at 95 which is, in my  
23 opinion, sufficient -- insufficient.

24 So, I encourage you to shift your whole thing to  
25 EER and COP, and that way you could also incorporate

1 other technologies into your calculations, rather than  
2 using these two -- three extremely bogus numbers.

3 MR. HOELLWARTH: I think that would be a good  
4 start.

5 On another item, can the industry put anything  
6 together as a proposal for our policy change in that  
7 area, because that's something that could be addressed  
8 by whatever we decide as a group to develop these  
9 policies going forward. Okay, great. Well, whatever we  
10 have, that's fine. That's what we're looking for right  
11 now is direction on policy.

12 MS. MELINE: That's where we're going to be  
13 tomorrow.

14 MR. HOELLWARTH: Pardon me?

15 MS. MELINE: That's what we were going to do  
16 tomorrow, work on that.

17 MR. HOELLWARTH: Oh, okay.

18 MR. KAVANAUGH: But you do -- you know, you do  
19 have to fight the Federal Government on this. But, you  
20 know, it's not the first time that California's -- you  
21 know, I got weed eaters, you can't use weed eaters  
22 because of California, and very polluting weed eaters  
23 because of you all's leadership so --

24 MR. HOELLWARTH: Preemption is definitely on the  
25 agenda all the time for ways to get around that.

1           MR. LOYER: The Energy Commission is actually no  
2 stranger to a fight with the Federal Government, so --

3           MR. HENRY: Yeah, I've been there a couple of  
4 times.

5           MR. HUDLER: Yeah, I think the key, you know, is  
6 to try to make it a fight is an eight-year fight, and we  
7 probably don't want to get into an eight-year fight.

8           But again, the Federal regulation is for  
9 appliance certification, it's not necessary for  
10 modeling. Again, the certification, the SEER is a  
11 requirement for certification for sale of a device in  
12 the United States. It is not necessarily a number  
13 required for modeling purposes.

14          MR. KAVANAUGH: Yes, but you could switch.

15          MR. HUDLER: We have to be creative, but we  
16 could switch.

17          MR. SPLITT: What are you --

18          MR. HUDLER: Pat, yeah, I'm referring to the  
19 reference for the standard design. So, if I use a  
20 package air conditioner, it has to have an SEER of 13.  
21 That's what I'm staying.

22          MR. SPLITT: For the standard in the package.

23          MR. HUDLER: For the standard reference. So,  
24 that's what all this thinking is on. And I'm saying we  
25 can step away from that because that is only related to

1 the requirement for certification for a device for sale.  
2 It's not necessarily saying that absolutely you have to  
3 use that in the modeling purposes.

4 MR. SPLITT: Especially if the unit is never  
5 rated in SEER.

6 MR. HUDLER: Right, and then there's that  
7 question, too. So, I think the door is open, it's just  
8 a matter that, you know, again, you know the ACM. There  
9 is not just one formula that needs to be changed, there  
10 is a humungous amount of work that needs to be done to  
11 get there.

12 MR. SPLITT: Thanks.

13 MR. HENRY: So, then it begs the question -- it  
14 begs the question, since it sounds like we're using --  
15 you're using appliance rating, which is the -- you're  
16 using a modeling, a compliance and modeling system  
17 that's built on a requirement -- I'm trying to be  
18 careful of how I say this, built on a requirement that's  
19 pressed upon the appliance, itself.

20 And, quite honestly, that seems like not the  
21 best way to go. One could make an argument, you know,  
22 maybe it is better, similar to what Dr. Kavanaugh was  
23 alluding to is scrap it -- scrap it and start with what  
24 makes the most sense, at least for this technology,  
25 perhaps.

1           Because after seeing -- getting a better handle  
2 of the rule sets going on, and a number of the other  
3 points you brought up earlier, it's like, you know, why  
4 throw smoke and mirrors at smoke and mirrors. You know,  
5 let's get to the facts. That's really what the industry  
6 wants to do, let's just get a factual representation of  
7 what the technology -- what the technology does.

8           MR. HOELLWARTH: Anybody else? Let me just run  
9 through my list here and see if anything gets a chord  
10 that maybe we need to clarify or discuss further.

11           One of the barriers was common public -- or  
12 something to do with public knowledge in terms of the  
13 lack of understanding of the technology, in general, by  
14 the consumer or consumer organizations. Is that -- I  
15 mean, is that fair to say?

16           And that is something that probably is a shared  
17 responsibility, but that would be something that we  
18 would want to say, say that the Commission could. And,  
19 I mean, I think that we could look into definitions of  
20 terms, looking at how we describe the system.

21           And I think the term "factual" is important. I  
22 think it's in probably the best interest of our  
23 consumers in the State to understand the system  
24 correctly and not to have somebody sell them something  
25 that isn't correct.

1           I think Steve's been saying get away from the  
2 marketing, the pure marketing approach and get into, you  
3 know, actual facts about the system that we all agree  
4 on, and that that's the basis for our discussion. So,  
5 that's something that we could go ahead on.

6           I heard something about engineers not being  
7 trained properly in these technologies. That's  
8 something that you could bring up, I think, and carry  
9 forward.

10           We're not in the business of training engineers,  
11 so I don't see that as pretty much of a responsibility,  
12 or part of State policies.

13           But let me just keep going through here and then  
14 let's come back. So, educating the public in terms of  
15 facts about the system is something I can see we could  
16 put on board.

17           The loop standards, I think, or the well  
18 standards that we talked about earlier, of course, are  
19 in another agency right now and I think Dennis's comment  
20 is good that we're going to look at trying to coordinate  
21 the different State inputs into this process.

22           But there are also local ones that have been  
23 brought up and Dennis alluded to 78 different permitting  
24 agencies, so we probably want to take that up as part of  
25 our discussion going forward.

1           MR. LOYER: I would also just like to add that's  
2 probably more like 578.

3           MR. HOELLWARTH: Yeah. Well, I think that we're  
4 not including in here -- if you get into the discussion  
5 of 15 percent beyond code, and that probably leads to  
6 the next issue and that is compliance software. If  
7 we're going to demonstrate 15 percent above, we have a  
8 number of programs. The New Solar Home Partnership was  
9 alluded to. But Joe's well aware of the 48 or 50 local  
10 standards that we have to approve that go beyond our  
11 minimum standards, and we need techniques for  
12 demonstrating 15 percent beyond for that, as well.

13           If you want to be included in that going  
14 forward, then geothermal heat pumps are going to have to  
15 have accurate algorithms, analysis techniques to  
16 demonstrate that to these localities.

17           And a very strong one that I heard was the  
18 compliance software and the basis for determining how  
19 good a geothermal system really is on a particular  
20 project. So, that should be on the agenda, I think,  
21 going forward. And we'll need some input from the  
22 industry on that.

23           Another item that Rob brought up was the HERS  
24 rating and inspection standards, practices. That's an  
25 area that is an area, I think, that we've talked with

1 the industry about before in terms of clarifying what is  
2 required, how do you approve a ground loop for  
3 installation and getting a permit.

4 Now, because we're just talking -- and I think I  
5 heard that we're just talking about permitting a  
6 project, and that is not necessarily the problem. The  
7 problem is going forward how much better is it than  
8 another system? How do you compare it to other systems  
9 going forward?

10 In our HERS requirements we don't have anything  
11 for geothermal heat pumps, so we would need help from  
12 the industry to really identify what's required, what  
13 sort of certification's in, who could certify, are there  
14 well logs that are required to be registered? What are  
15 the things we need to make sure that the ground loop is  
16 sized properly for the system and it's going to work the  
17 way the consumer expects it to work or has been told  
18 that it's going to work?

19 I think that's a very important one.

20 We talked a little bit about renewable  
21 definitions in the State of California. Well, at the  
22 Energy Commission we really look at renewables as an  
23 electrical term, but it has a broader application --

24 MR. HENRY: That's the slide I skipped over.  
25 That's the slide I skipped over, Greg.

1           MR. HOELLWARTH: Yeah, I know, but it is one  
2 that maybe we have to clarify. I know our staff  
3 discusses that all the time. And that can be brought up  
4 by the industry in terms of how we're going to define  
5 renewables, one for electrical systems and maybe  
6 something going beyond that.

7           MR. LOYER: That's also a discussion that we're  
8 going to be having with other State agencies, the CPUC,  
9 as well as the ARB.

10          MR. HOELLWARTH: Right.

11          MR. LOYER: That's not just a definition that  
12 we're in charge of, although that one is ours, but it is  
13 something that we have to discuss with other agencies to  
14 get them on board.

15          MR. HENRY: Oh, can I just ask a clarifying --  
16 sorry, Craig.

17                 So, the -- in California, the responsibility for  
18 defining a renewable technology lies with the Energy  
19 Commission. Is that what I just heard you say?

20          MR. LOYER: No. Defining that lies with both  
21 ARB, to a large extent, and to the CPUC, to a much  
22 larger extent.

23                 It is more like an agreement that the three  
24 agencies have to come to in order to make our various  
25 programs work.

1           We have responsibility for energy efficiency  
2 programs. The CPUC has a responsibility to make sure  
3 that what the utilities are offering as a rebate program  
4 for efficiency measures is in line with what we have for  
5 efficiency measures.

6           The 33 percent RPS has to be a definition that's  
7 not only agreeable with ARB, but with CPUC and us and,  
8 so far, have been on the generation side, only.

9           But there is -- and it's electric generation.  
10 But there isn't really a reason, technically, why not it  
11 couldn't, but it has not gone to that point of saying a  
12 non-generating renewable.

13           So, that's where it is right now. There's no  
14 reason that discussion -- and that discussion is always  
15 ongoing. There's no reason that discussion can't  
16 continue to go down the appropriate line.

17           MR. HOELLWARTH: And this is something that, you  
18 know, the industry could bring forward as a policy  
19 change, but you're going to have to have -- on all of  
20 these things, the industry's going to have to come up  
21 with data, case studies, information to justify, you  
22 know, the proposed change in policy or new policy that  
23 we want to include in the IEPR going forward.

24           Maybe one last thing was I know Paul talked a  
25 lot about utility programs and policies related to

1 utility programs. That's why I asked about the CPUC.  
2 We don't have jurisdiction over utilities so -- but the  
3 CPUC does, and they're a sister organization. So, we  
4 certainly can work with them in developing policies  
5 related to utilities, but we'd have to identify what  
6 that would be, and how we would justify that.

7           The utilities do conduct workshops on new  
8 technologies they recommend for consideration by the  
9 Commission in its standards on the -- every cycle that  
10 we go through, now, probably that will be the case.

11           So, I would suggest that the industry  
12 participate in those workshops, as well, to identify  
13 strategies or actions that you think should be  
14 considered for the standards, whether they be  
15 requirements or they be things like the ACM, ways of  
16 approving tools to be used with the standards.

17           So, there's a lot of area there you can get  
18 into. One thing we didn't talk about today, but we'll  
19 probably have to talk about along the way, is California  
20 is unique in that we look at the peak power costs, I  
21 guess you'd say, or impacts through our TDV process, our  
22 time dependent valuations.

23           And so, I know Rob's very familiar with this,  
24 but every hour of the year there's a value for the power  
25 or the energy that you use. And that's included when we

1 do our analysis of a building, that 8,760 hours, what is  
2 the value of the peak power at that particular point in  
3 time.

4 So, that's another thing to consider. We're looking  
5 at that a little differently than you might look at  
6 source energy in other states, or other approaches. And  
7 we'd have to make sure that we're in sync on those kinds  
8 of things.

9 That's pretty much my short list. We didn't  
10 have the CPUC here today, but we -- according to the  
11 legislation, we're going to actively pursue that to make  
12 sure that the CPUC is involved in the process in some  
13 way and --

14 MR. LOYER: We do have good contacts over at the  
15 CPUC. They were not able to attend today, shockingly,  
16 because they are currently attending a workshop with the  
17 utilities, talking about energy efficiency measures.

18 MR. HENRY: Who picked this date?

19 MR. LOYER: I don't know how that happened, but  
20 there you are.

21 And we will also be working with the California  
22 Air Resources Board, that's also required within 2339.

23 I do have a contact over there and we will be  
24 having them on our working group.

25 MR. HOELLWARTH: And another thing, in the

1 workshop today we got a lot of stress placed on  
2 residential buildings, or it seemed to be. I think we  
3 need to really develop the nonresidential side of  
4 things, as well, in terms of how the geothermal systems  
5 can impact that sector of our building systems.

6 MR. HENRY: I agree, both need to be developed,  
7 but in terms of the lowest hanging fruit and the  
8 shortest near-term opportunity or loss of opportunity,  
9 which is what I'm most concerned about, it's actually  
10 the nonres stuff.

11 MR. HOELLWARTH: There's terrific opportunity  
12 there, as I understand it, so I think we should be  
13 pursuing that end, as well as the residential, which  
14 seems to have a lot more barriers.

15 Joe, do you want to talk at all about our next  
16 steps going forward?

17 MR. LOYER: I can, briefly. We are a little  
18 over time. But, briefly, the next steps going forward  
19 are really going to be fun. We're going to put together  
20 a policy document.

21 We are going to start with Negatherm and we are  
22 going to build policy recommendations off of that work  
23 since, heck, we did in fact pay for it, so what the  
24 heck.

25 MR. HOELLWARTH: Yeah.

1           MR. LOYER: So, we're going to start with the  
2 policy document there. This policy document is going to  
3 be open to any working group member to add to, detract  
4 from, make their recommendations, make their case for  
5 their recommendations.

6           And, essentially, what we're going to get out of  
7 this, we're going to have -- officially, we're going to  
8 have no back and forth between the staff and Commission,  
9 Commission representatives, but we will be talking to  
10 their advisors as we are permitted to do.

11           There are, definitely, so what do they call  
12 this, the Chinese wall. There are definitely -- there  
13 is definitely a Chinese wall between us and the  
14 Commissioners. We are not their staff. We are staff,  
15 they are the Commissioners.

16           And so we will be running some ideas past their  
17 advisors, and their advisors will tell us, you know,  
18 that there's no way we're doing that or, yeah, that  
19 sounds good.

20           And from that point we'll be putting together a  
21 short list of the policy recommendations that we want to  
22 go forward with.

23           Once we have that policy recommendation document  
24 together, we'll be putting that -- that's going to be  
25 about a 10-page document or so, you know, maybe more and

1 maybe less. That will be potentially included in the  
2 IEPR. That work has to be done by June.

3           Once that document is in its draft form and  
4 given to the IEPR Committee to review and approve,  
5 they'll do some back and forth with us. At the very  
6 least, I'm thinking, several times we'll be talking to  
7 them.

8           And then at some point over the summer that  
9 document will finalize. It will be read or heard by the  
10 entire Commission at a Business Meeting, and I believe  
11 it is November and approved at that point. And then  
12 that will become the policy that we move forward with.

13           And so, I think in this particular context, in  
14 this particular effort we have -- you have a sort of  
15 unique opportunity to affect our policy, I think more  
16 than any other group has really been allowed to do.

17           We typically don't let industry affect our  
18 policy too much because we've had some bad experiences.  
19 So, we've had some bad dates in the past.

20           (Laughter)

21           MR. LOYER: And so, we tend not to do that too  
22 much. But in this particular case there are so many  
23 barriers that we need to overcome, there are so many  
24 nuances to the regulations -- not regulations, but the  
25 policies that we need to develop that I think it

1 behooves us to include industry as much as possible.  
2 And to especially include people who have, so to speak,  
3 boots on the ground, who have experiences with actually  
4 putting the systems in, what the barriers they've had to  
5 overcome were, and then go right up the line to the  
6 major overall State leadership issues that we definitely  
7 have on this issue.

8 I think if we can fold both industry and then  
9 our three major State agencies into this discussion, I  
10 think we might end up with a good document.

11 I say that knowing full well I am in March and  
12 it's due in June. So, we will have to move fast.

13 MR. HOELLWARTH: Yeah.

14 MR. LOYER: But that is what's coming next.

15 MR. HOELLWARTH: And I think that -- let's put  
16 the stress on that, too. Any input we receive from the  
17 industry we need soon, and it needs to be well thought  
18 out. So, I'm going to suggest to take the time to  
19 really think it through, identify those key policies or  
20 issues that you want to bring forward that we can really  
21 work with our other agencies and our staff to really  
22 develop into an IEPR document.

23 I appreciate very much the folks that are here  
24 from outside the area, taking time to come down here,  
25 thank you much. It's been a long day.

1           I know it's not going to end here, it sounds  
2 like. Maybe Phil will have an announcement here as we  
3 close. But I wanted -- appreciate that.

4           We're looking for input from the industry,  
5 outside the state, inside the state. Keep in mind this  
6 is California, though, and while people are doing things  
7 around the country, it does usually have to go through  
8 some kind of filter for us to really take it on here.

9           Bill, do you want to --

10          MR. LOYER: Just for the record, I've requested  
11 anyone online to raise their hand if they'd like to make  
12 a comment, and no hands were raised, no comments were  
13 offered.

14          Phil?

15          MR. HENRY: Yeah, I'll just remind everyone  
16 we're going to adjourn to de Vere's on L Street,  
17 immediately following and we can continue the  
18 conversation over iced tea, or coffee, or food,  
19 chocolate milk.

20          MR. HOELLWARTH: What's the cross street?

21          MR. HENRY: It's between 15th and 16th on L  
22 Street, 1521 L Street.

23          MR. HOELLWARTH: Great. Thank you all for being  
24 here and look forward to hearing from you again sometime  
25 soon. Thanks.

