Identifying Research Priorities on Flexibility and Other Operational Needs for Existing Geothermal Power Plants:
A Pre-Solicitation Workshop

California Energy Commission

Charles Imbrecht Hearing Room

January 28, 2016

Chuck Gentry, Rizaldo Aldas

Energy Generation Research Office

Energy Research and Development Division

Housekeeping

- In Case of Emergency
- Facilities
- Sign-In Sheet

Commitment to Diversity

The Energy Commission adopted a resolution strengthening its commitment to diversity in our funding programs. We continue to encourage disadvantaged and underrepresented businesses and communities to engage in and benefit from our many programs.

To meet this commitment, Energy Commission staff conducts outreach efforts and activities to:

- Engage with disadvantaged and underrepresented groups throughout the state.
- Notify potential new applicants about the Energy Commission's funding opportunities.
- Assist applicants in understanding how to apply for funding from the Energy Commission's programs.
- Survey participants to measure progress in diversity outreach efforts.

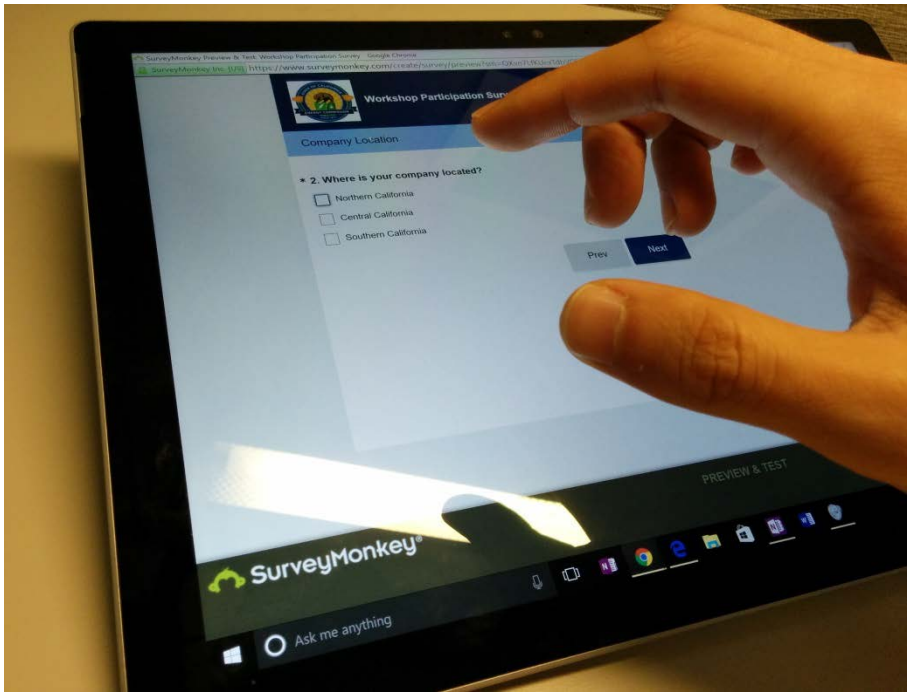
We Want to Hear From You!

1 Minute Survey

- The information supplied will be used for public reporting purposes to display anonymous overall attendance of diverse groups.

- **iPads are being passed around the room**

- **Online SurveyMonkey for WebEx Participants:**
  https://www.surveymonkey.com/r/CEC-1-28-16
  Thanks for your time!



Agenda

Part I: Presentations

1:00 – 1:05 Welcome and Introductions

1:05 – 1:15 Geothermal R&D with the California Energy Commission
Chuck Gentry, California Energy Commission

1:15 – 1:45 Operational Flexibility of Geothermal Power
Julio Garcia, Calpine Corporation

1:45 – 2:00 Q&A

Agenda

Part II: Panel Discussion

2:00 – 3:30 Panelist Introductions and Panel Discussion

Moderator: Rizaldo Aldas, California Energy Commission

Panelists: Steve Ponder, Geothermal Resources Council

Julio Garcia, Calpine Corporation

Josh Nordquist, Ormat Technologies

Randy Keller, CalEnergy Operations

John Muir, GreenFire Energy

Andy Van Horn, GreenFire Energy

3:30 – 4:00 Panel Q&A and Public Comment

Geothermal Research & Development with the California Energy Commission

Chuck Gentry
Energy Generation Research Office
Energy Research and Development Division

State Energy Policy Drivers

	2008	2010	2013	2015	2016	2020	2025	2030	2050
Energy Efficiency	40,000 GWh/year		63,000 GWh/year		Zero Net Energy Residential Buildings Goal	Zero Net Energy Commercial Buildings Goal Double Energy Savings in Existing Buildings Goal			
Demand Response	Economic DR at 5% of peak Goal		Achieve 100% of Economic Potential Goal						
Renewable Energy	11% RPS Goal		20% RPS Goal		33% RPS Goal 12 GW DG Goal 8 GW Utility-Scale Goal		50% RPS Goal		
Transportation Energy			10% Light-Duty State Vehicles be ZEV		25% of Light-Duty State Vehicles be ZEV	Over 1.5 million ZEVs on California Roadways Goal			
Greenhouse Gas Reductions					Reduce GHG Emissions to 1990 Level (AB 32) – Represents 30% Reduction from Projected GHG Emissions		Reduce GHG Emissions by? (TBD - Interim Goal)		Reduce GHG Emissions 80% Below 1990 Levels (Exec. Order)

CEC Geothermal Funding Programs

- *Geothermal Grant and Loan Program (also known as the GRDA Program)*
  - The Energy Commission's Geothermal Grant and Loan Program started in 1980 under AB 1905 and is funded by the state's Geothermal Resources Development Account (GRDA). GRDA funds come from royalties paid by geothermal developers for leases on federal land in California.
- *Geothermal R&D under PIER*
  - Electric Public Interest Energy Research (PIER) Program was initiated in 1997 by AB 1890. Funding comes from IOU ratepayers. A number of geothermal projects where funded under this program.
- *Geothermal R&D under EPIC*
  - At the Governor's request, the CPUC created the Electric Program Investment Charge (EPIC) in 2012. Funding comes from IOU ratepayers. One geothermal project has been funded so far.

Electric Program Investment Charge (EPIC)

- Established by CPUC in 2012 to fund investments to advance clean energy technologies and approaches for the benefit of investor-owned utility electricity ratepayers.
- The Energy Commission administers approximately $130 million per year.
- EPIC uses an **energy innovation pipeline** approach to creating new energy solutions, fostering regional innovation, and bringing clean energy ideas to the marketplace

Geothermal R&D Under EPIC

Second Triennial Investment Plan (2015-2017)

- Strategic Initiative: S4.3 Develop Advanced Technologies and Strategies to Improve the Cost-Effectiveness of Geothermal Energy Production.
  - Applied research and development activities.
  - Research on strategies, modeling, materials, and component designs that will help existing geothermal facilities improve capacity, productivity, and efficiency; and lead to reduced wear, and improved ability to ramp up or down rapidly on demand in flexible mode.
  - Research on improvements to geothermal resource characterization and development tools and analytical techniques to help reduce costs and risks associated with geothermal exploration and development.

Geothermal Exploration, Economic Feasibility and Market Analysis and Distributed Energy Resource Demonstration

Company: County of Modoc

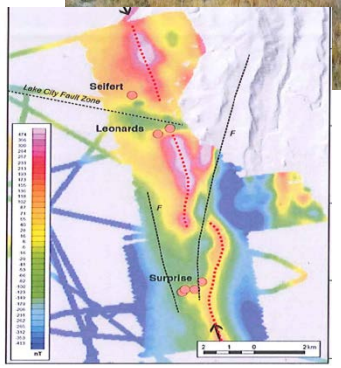
GEO-14-003

Goals: To install and demonstrate the effectiveness of a small distributed energy geothermal unit to generate electricity in a rural community; conduct site-specific geological studies to identify a deeper, hotter geothermal resource for development; and to generate an economic feasibility study.

Features & Benefits:

- Increase public exposure to geothermal technology
- Demonstrate the operation & benefits of a small energy unit using the existing Surprise Valley Hot Spring geothermal surface flow
- Surprise Valley Hot Spring flows at 3,000 gpm at 208°F (out of the known 304 hot springs in CA, it is the 3rd hottest)

Surprise Valley Site
Source: CA Geo Energy Collaborative



Concerns:

- Limited transmission capacity in existing lines; high voltage transmission lines & construction of large power plants are costly

Project Amount	Match Amount	Start Date	End Date
$1,129,619	$369,588	3/11/2015	3/31/2017

Technologies for Extracting Valuable Metals and Compounds from Geothermal Fluids

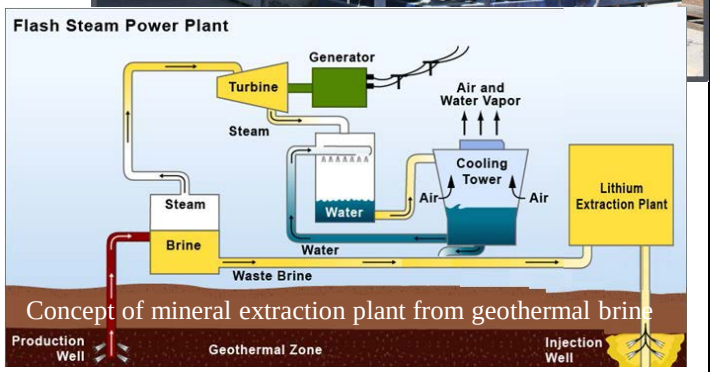
Company: Simbol, Inc.
PIR-10-059

Simbol's lithium extraction pilot plant Calipatria

Goal: To advance the geothermal industry by developing extraction technologies to remove silica and other materials from geothermal brines and transform them into sellable products.

Features & Benefits:

- Tax revenues generated by in-state sale of lithium products
- Increased job demand in lithium production plants or manufacturing operations
- Potential at 11 geothermal plants that generate 377 MW
- Estimated annual production from a 50 MW plant → 15,000 tonnes of lithium carbonate, 24,000 tonnes of electrolytic manganese dioxide, 8,000 tonnes of zinc, and 410,000 tonnes of potash (KCL)



Concept of mineral extraction plant from geothermal brine

Source: CEC PIR-10-059 Final Report

Results:

- >95% of lithium was extracted from geothermal brine. Commercial lithium plant estimated to produce 15,000 tonnes/year of lithium carbonate and a gross revenue of $80 -$100 million annually.

Project Amount	Match Amount	Start Date	End Date
$380,000	$6,280,682	6/30/2011	3/31/2014

Caldwell Ranch Exploration and Confirmation Project

Company: Calpine Corporation
PIR-10-060

Goal: To explore and confirm the resource potential indicated by the wells with a focus on the steam characteristics of the high temperature zone in the Caldwell Ranch Area

Features & Benefits:

- The results can reopen or expand 3 abandoned wells in Caldwell Ranch Area
- Caldwell area expected potential is 22- 45 MW
- The 3 wells approximate production is 2.5 MW each
- Characterization techniques include high temp PTS log, noble gas isotope collection, and reservoir-scale fracture analyses using micro-earthquake data

Steam emanating from the Caldwell Ranch drill rig
Source: Geysers Power Company

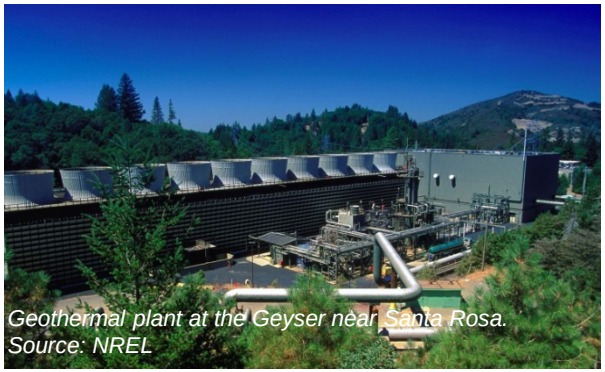
Results:

- The flow testing and production of the project wells confirms that the Caldwell Ranch project area plus a portion of the adjacent Enhanced Geothermal System (EGS) Demonstration area is capable of supplying a sustainable steam supply of 40-45 megawatts of gross electrical power for the proposed Wild Horse Power Plant.

Project Amount	Match Amount	Start Date	End Date
$410,000	$12,531,927	4/28/2011	6/3/2013

Investigating Flexible Generation Capabilities at the Geysers

Company: Geysers Power Company, LLC
EPC-14-002


Geothermal plant at the Geyser near Santa Rosa.
Source: NREL

Goal: Define flexible generation capabilities and limitations at The Geysers and determine costs and risks.

Features & Benefits:

- Ratepayer benefits of greater electricity reliability and lower costs
- Technological advancement & barriers to overcome
  - Development of computer model to optimize steam field management during flexible time periods
  - Determine potential & existing electrical generation limits
  - Constructing low volume steam flow monitoring capabilities at the well heads to prevent pipeline corrosion, wellbore formation, well damage, and for detection of non- condensable gas accumulated in the pipelines.

Approach

- An integrated model will be tested at an isolated well(s), pipeline, and power plant, and then at a cross-tied location.

Project Amount	Match Amount	Start Date	End Date
$3,000,000	$3,000,000	1/5/2015	3/31/2018

Next steps after this workshop

- Gather comments/feedback and develop the grant solicitation
- Geothermal topic will be included under a larger solicitation that covers two other technical topic areas (wind and small hydro)
- 2 phase solicitation; target release around Spring 2016

Comments can also be submitted via email to:

chuck.gentry@energy.ca.gov

using the email subject heading:
"COMMENTS: Geothermal Workshop"

Deadline for comments is Thursday, February 4, 2016 at 5 pm PST

Operational Flexibility of Geothermal Power

Julio Garcia
Calpine Corporation

Q&A

- Please state your name and affiliation
- Please limit your questions or comments to 3 minutes

Panel Discussion

Rizaldo Aldas
Energy Generation Research Office
Energy Research and Development Division

Expert Panelist Introductions

- Steve Ponder, Geothermal Resources Council
- Julio Garcia, Calpine Corporation
- Josh Nordquist, Ormat Technologies
- Randy Keller, CalEnergy Operations
- John Muir, GreenFire Energy
- Andy Van Horn, GreenFire Energy

Panel Discussion

Question 1

- What are the main barriers and opportunities to operating geothermal power plants in flexible or load following mode? What are the main operational and maintenance cost drivers of geothermal power plants running in flexible or load following mode? What research and development activities should be conducted to address these barriers and cost drivers?

Panel Discussion

Question 2

- What other operational issues are limiting the success of geothermal power plants and what research and development activities should be conducted to address these issues?

Panel Discussion

Question 3

- What specific geothermal generation technologies or enabling technologies have significant potential to succeed in the California market and why? What further research and development is needed, if any, to accelerate the market adoption of these technologies or strategies?

Panel Discussion

Question 4

- What is the current potential or opportunities for expanding power generation from geothermal and boosting its role in meeting California's renewable energy goals? What are the main barriers preventing more geothermal power from being added to the grid in California?

Q&A and Public Comments

- Please state your name and affiliation
- Please limit your questions or comments to 3 minutes

Connect With Us

Commission's listserves
www.energy.ca.gov/listservers

Thank You!

Please email comments to

Chuck Gentry at

chuck.gentry@energy.ca.gov

Using the email subject heading:

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