



Strategic Analysis

Project Officer: Tim Reinhardt

Total Project Funding: \$300k

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Systems Analysis: Systems Analysis, Resources
Assessment, Data System Development &
Population, Education

What are the issues likely to be strategically important to the Geothermal Technologies Office (GTO) several years in the future?

Specific objectives for this project are:

- **Identify the potential for and any corresponding barriers to doubling geothermal deployment by 2020**
 - *Can geothermal contribute to the President's goal of doubling renewable energy generation by 2020?*
- **Provide potential deployment targets and scenarios for years 2030, 2040 and 2050**
 - *How much geothermal is likely to come online, by when, and what types?*
- **Assess geothermal heat markets in the United States**
 - *Where can geothermal direct use compete with other energy options ?*
- **Develop 3-year projection of geothermal strategic issues with a plan for analysis studies to inform decisions.**
 - *What does the industry need to do to position geothermal for success? What options are possible to overcome barriers to this success?*

The impact of this project is insight and foresight:

This work will identify issues likely to be important to GTO in upcoming years and analyze strategic knowledge gaps in these areas.

When completed, this project will help GTO to make more informed decisions on the studies and information needed to meet goals, such as:

Accelerate development of 30 GWe of undiscovered hydrothermal resources



“Doubling Geothermal by 2020” will help GTO to identify barriers to projects under development,
➤ GTO can then develop strategies to remove barriers

Achieve 3 GWe of installed low-temperature geothermal electric (or thermal equivalent) capacity by 2020



Assessing the geothermal heat markets in the US will provide vital fundamental knowledge on competition
➤ GTO can then form strategies for development

Drive industry deployment toward target of 100+ GW of EGS



Developing outyear projection to aid GTO with timelines for deployment targets and R&D advances
➤ GTO can then set technology goals & targets

Technical approaches used in **completed** analyses include:

Doubling Geothermal by 2020

- ✓ Compile project data
- ✓ Identify development status and project barriers
- ✓ Categorize type and severity of barriers in impacting project viability
- ✓ Assess potential for deployment by 2020, given identified barriers.

Approach to Out-Year Projections

- ✓ Update ReEDS model to accommodate more types of geothermal electricity generation technologies
- ✓ Update geothermal supply curves inputs and assumptions to match most recent cost and resource data and GTO goals.
- ✓ Perform preliminary ReEDS model runs with most recent geothermal supply curves to estimate potential market deployment with expanded range of geothermal technologies

Planned technical approaches for analyses **not yet completed** include:

Geothermal Heat Market

- Analyze geothermal heat market resource potential
- Compile heating/thermal demand by region, co-located with resource potential
- Characterize geothermal heating (direct use) technology and cost
- Compare cost of geothermal relative to alternative heating options (competition analysis)

Doubling Geothermal by 2020: Project Analysis

What can be used to define project development status and viability?

Project Status		Category	Description
Where is it now?	Project Development Phase *	Prospect	Regional Reconnaissance
		Phase I	Resource Procurement and Identification
		Phase II	Resource Exploration and Confirmation
		Phase III	Permitting and Initial Development
		Phase IV	Resource Production and Power Plant Construction
Where is it going?	Status **	Ongoing	Projects currently in development.
		Postponed	Projects no longer in development but <u>with</u> the intention to resume exploration at a later date.
		Discontinued	Projects no longer in development and with <u>no</u> intention to resume exploration at a later date.
Will it be completed by 2020?	Strategic Viability (NREL Designation)	Likely	On track to come online by 2020 given current and past progress (assuming no new hurdles).
		Potential	Indicates additional effort required to advance exploration and development to come online by 2020 (i.e. current barriers and/or lack of project progress)
		Stalled	Exploration and/or development significantly slowed or stalled for a cause unrelated to resource availability
		Pre-Development	No on-site activities to date

* Based on GEA Report data. Verified through review of publicly available documents (news articles, company websites, regulatory permits)

** Based on SNL Financial data. Verified through review of publicly available documents (news articles, company websites, regulatory permits)

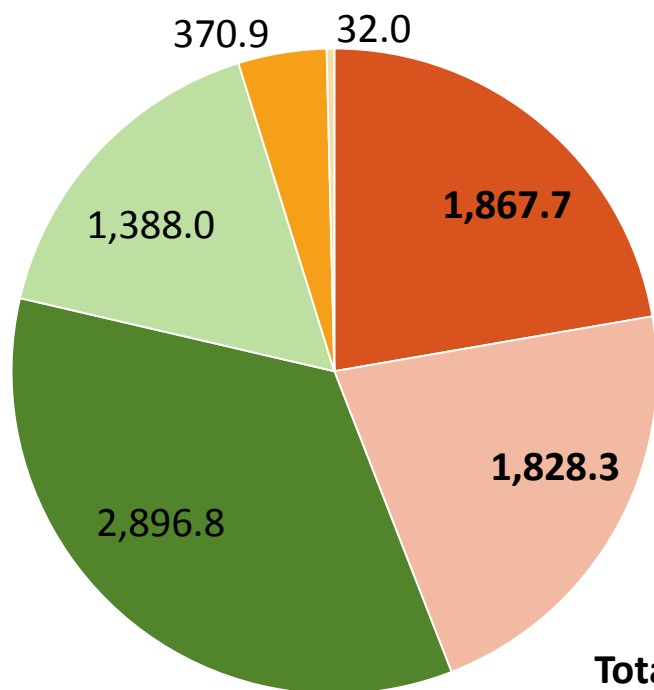
Doubling Geothermal by 2020: Project Analysis

What process was used to evaluate projects? *Example: Casa Diablo 4*

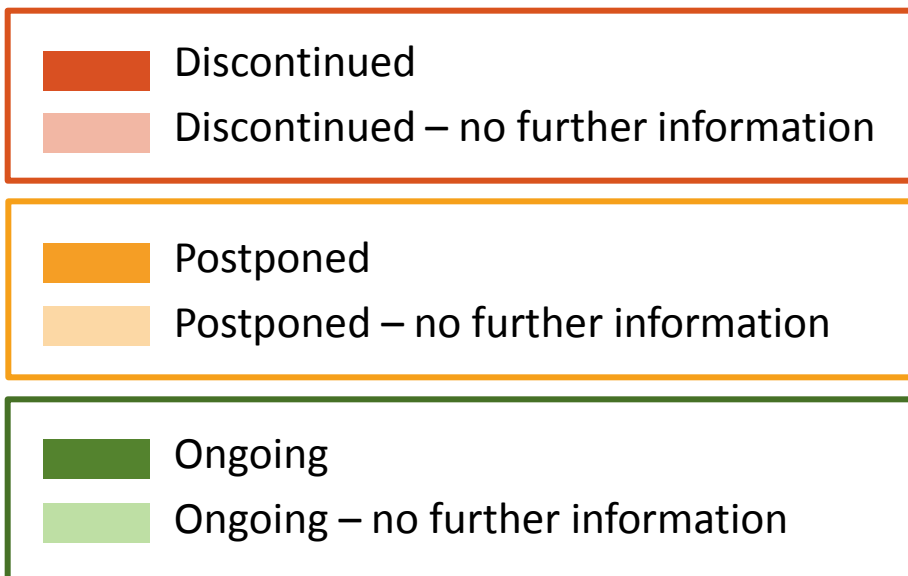
<p>1. Compile project data</p> <ul style="list-style-type: none"> Assembled projected capacity, location, status, and ownership data from both the GEA and SNL Financial, where available. Identified associated geothermal area and region based on mapping project GPS coordinates. 	<ul style="list-style-type: none"> Reviewed individual records from SNL Financial and GEA, and determined Casa Diablo 4 is equivalent to the project named CD4 (Mammoth Complex) Recorded GEA's 25 MW Planned and Resource Capacity, and SNL's Planned Capacity of 33 MW. Recorded GEA's project development <i>Phase 2</i> and SNL's development phase <i>Early Development</i> Recorded SNL's project status <i>Ongoing</i> Mapped SNL coordinates in Geothermal Prospector. Used region layer properties to categorize project as within the Walker-Lake Transition Zone Zoomed into OpenEI map of Geothermal Areas to categorize project as within Long Valley Caldera. Confirmed by mapping project in Google Maps.
<p>2. Identify development status and project barriers</p>	<ul style="list-style-type: none"> Read Ormat's recent 10-K to confirm ongoing status. Researched BLM permit status and news on blm.gov, finding Final EIS completed August 2013. Researched news on Casa Diablo 4 via Google searches, finding June 2014 press release from Mammoth County Water District <u>against</u> the project.
<p>3. Categorize severity of barriers in impacting project viability</p>	<ul style="list-style-type: none"> Interpreted qualitative results into categories: <div style="text-align: center; background-color: #f4a460; padding: 5px; margin-top: 10px;"> <p>Barrier = <i>Permitting – Community Viability = Potential</i></p> </div>

Doubling Geothermal by 2020: Project Analysis

Almost half of recent U.S. geothermal projects were discontinued – Why? Unknown.



Preliminary Results – DO NOT CITE!



Total Estimated Project Capacity (MW) (2012-2014): 8,384 MW
Also have analysis of barriers by Phase of Development – needs reviewed

Project Status:

Ongoing: Projects currently in development.

Postponed: Projects no longer in development but with the intention to resume exploration at a later date.

Discontinued: Projects no longer in development and with no intention to resume exploration at a later date.

No further information: Information not publicly available on anything to provide further analysis beyond project status

Out Year Projections: Supply Analysis

Approach to Out-Year Projections focused on ReDS and Supply Curve updates

1. Updated geothermal supply curves

- Used most recent version of GETEM developed in FY13
- Used updated default assumptions from conversations with industry in FY13
- Included base and improved cost assumptions from FY13 work
- Add information on near-field EGS from USGS
- Increased hydrothermal resource potential to reflect assumed impact of in-field EGS technology

2. Updated ReEDS model to accommodate more geothermal technologies

- Two cost scenarios - reference and improved capital costs
 - Reference - Current costs, no technology improvements
 - Improved - GTO technology targets, from FY13 work
- Undiscovered hydrothermal projects available starting in 2020
- EGS (NF and Deep) available starting in 2030
- In-field EGS available starting immediately

3. Performed preliminary ReEDS model runs with most recent geothermal supply curves to estimate potential market deployment

- What is deployment potential in 2030, 2040, 2050?

Out Year Projections: Modeled Deployment Analysis

Geothermal updates to ReEDS significantly improved model flexibility

Before

- ReEDS model designed to have input “tranches” for each technology
- Geothermal had **2 tranches**
 - Hydrothermal
 - EGS
- **Difficult to discern which geothermal technologies were being deployed**
 - Hydrothermal – included identified and undiscovered resources
 - EGS – included Deep EGS and Near-Hydrothermal Field EGS (NF-EGS)

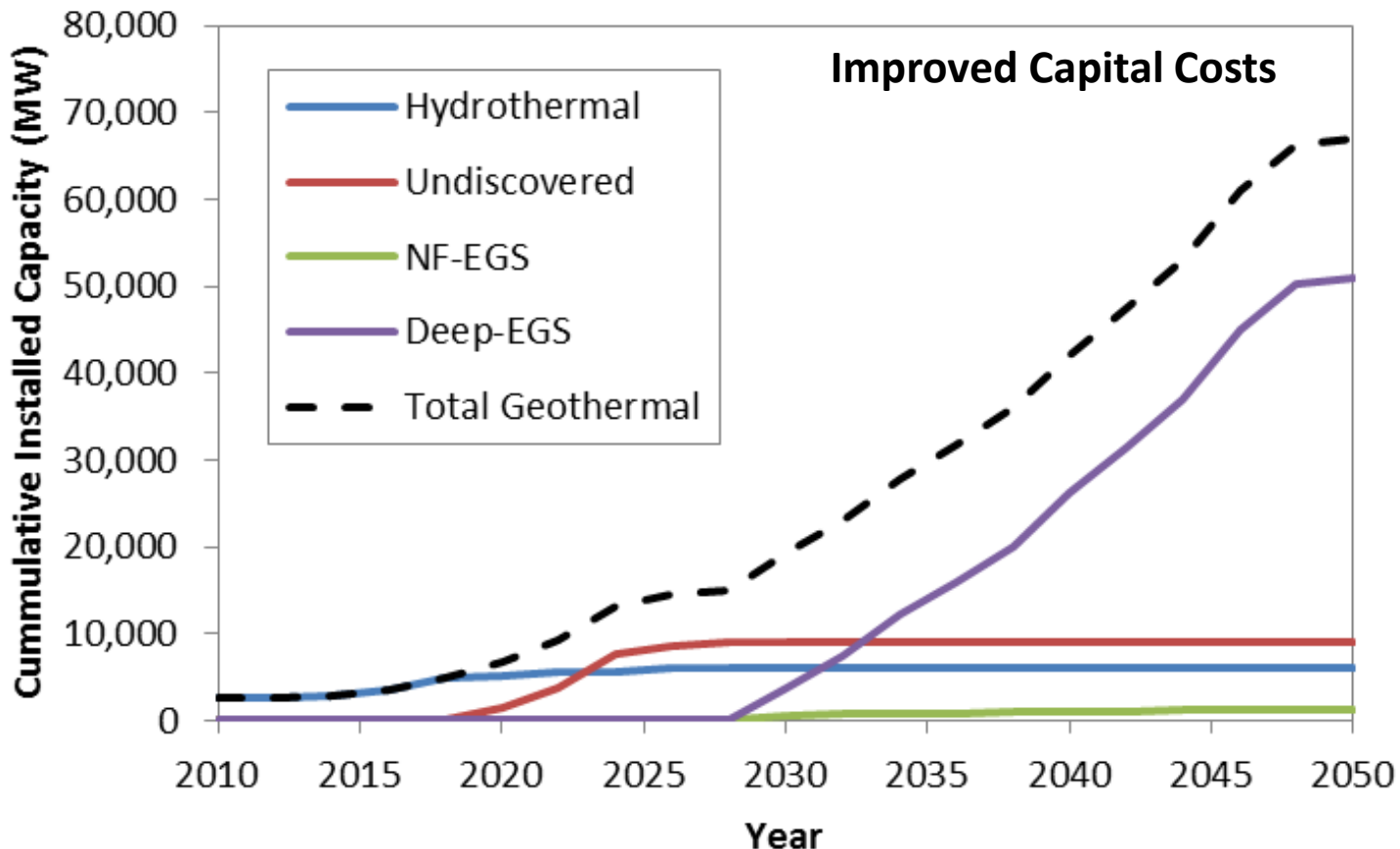


Updated (FY14)

- Geothermal has **5 tranches**
 - Identified Hydrothermal
 - Undiscovered Hydrothermal
 - NF-EGS
 - Shallow EGS (not used yet)
 - Deep EGS
- Can **identify easily which technology and resource type is deployed** by ReEDS
- Can also **easily apply different deployment assumptions** to geothermal technologies/resources now
 - Start year
 - Growth rate limits

Out Year Projections: Modeled Deployment Analysis

Cumulative geothermal installations may boom in 10 years with improved costs



Preliminary Results – DO NOT CITE!

Original Planned Milestone/ Technical Accomplishment	Planned Date	Date Results Presented
Complete analysis of the 2020 deployment doubling potential for geothermal power	9/30/14	10/9/14
Develop assumptions, inputs and outputs of ReEDS model runs, including deployment targets for out years 2030, 2040 and 2050	9/30/14	10/9/14

***Delay due to scheduling conflicts for presentation -
GRC National Meeting concurrent with year-end.***

Complete *analysis of geothermal heat markets*:

1. Analyze geothermal heat market resource potential
2. Compile heating/thermal demand by region, co-located with resource potential
3. Characterize geothermal heating (direct use) technology and cost
4. Compare cost of geothermal relative to alternative heating options (competition analysis)

Milestone or Go/No-Go	Status & Expected Completion Date
Write report documenting assessment of geothermal heat markets in the United States	<i>In Progress.</i> Coordinating work as part of Geothermal Vision Study
<u>Draft</u> 3-year projection of geothermal strategic issues with a plan for analysis studies to inform decisions	6/30/15
<u>Finalize</u> 3-year projection of geothermal strategic issues with a plan for analysis studies to inform decisions	9/30/15

This project has:

- identified the major barriers slowing deployment of geothermal projects,
- made estimates *for internal use by GTO* of the potential capacity of these projects that are likely to be deployed by 2020,
- updated the geothermal inputs to the ReEDS model, and
- developed out-year projections for geothermal deployment to 2050 under reference (business-as-usual) and improved cost scenarios.

These results are still under review and not ready for public dissemination.

Future work will focus on GTO's **information needs for strategic positioning:**

- identifying areas of strategic interest to GTO
(*e.g. via technical and demand maturity scenarios*)
- performing objective, credible analyses to inform GTO decision makers