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Deep Direct-Use Geothermal: Development of a Demand Side Model for the Hawthorne, Nevada Area

GRC Annual Meeting

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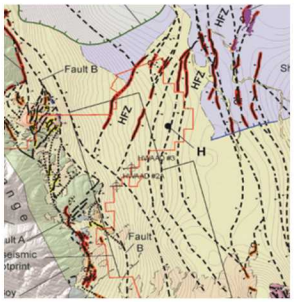
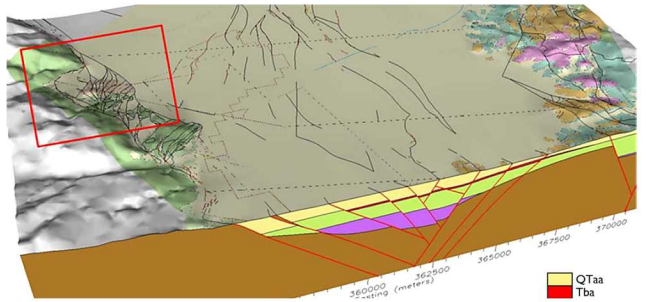
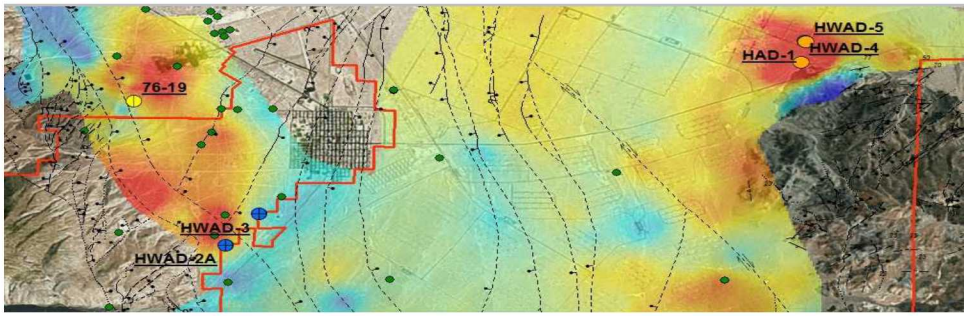
Ray Arguello







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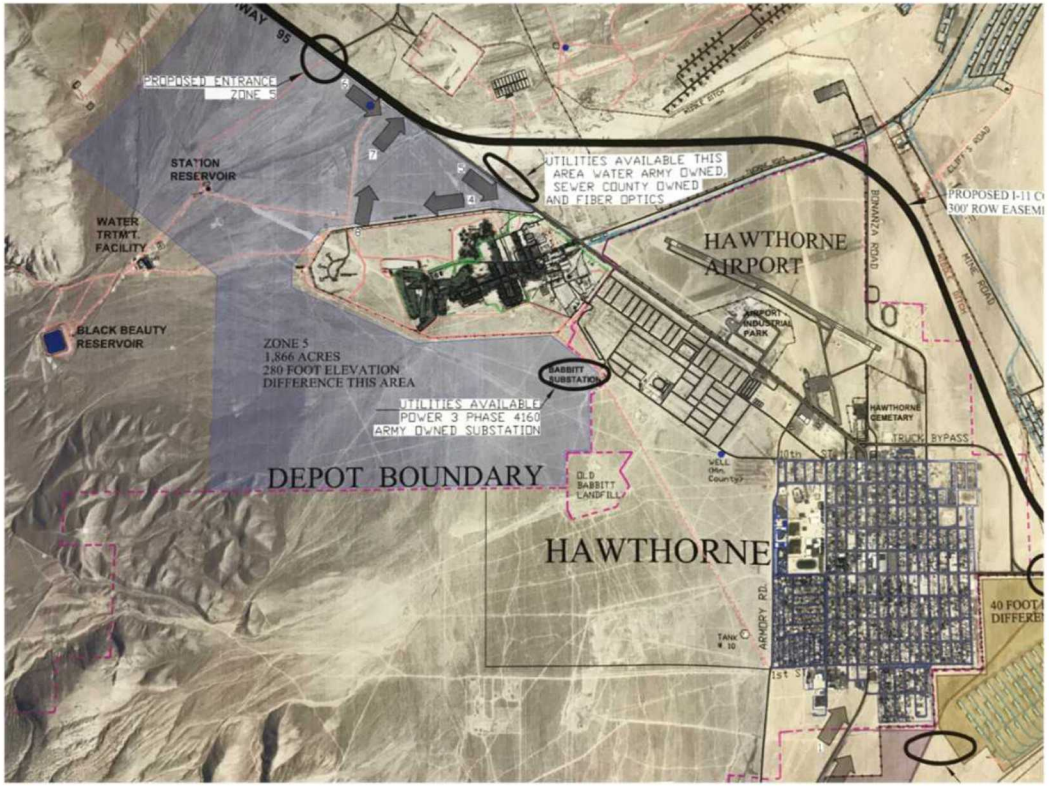
Today's Objectives

- Introduce Project Team
- Overview of Project
- Energy Available
- Process Flow Diagram
- Assumptions
- Trane Software Model and Potential Applications
- Decision Metrics



Project Team

Thomas Lowry[1]

Andrew Sabin[2]

Bridget Ayling[3]

Bill Harvey[4]

Andy Tiedeman[2]

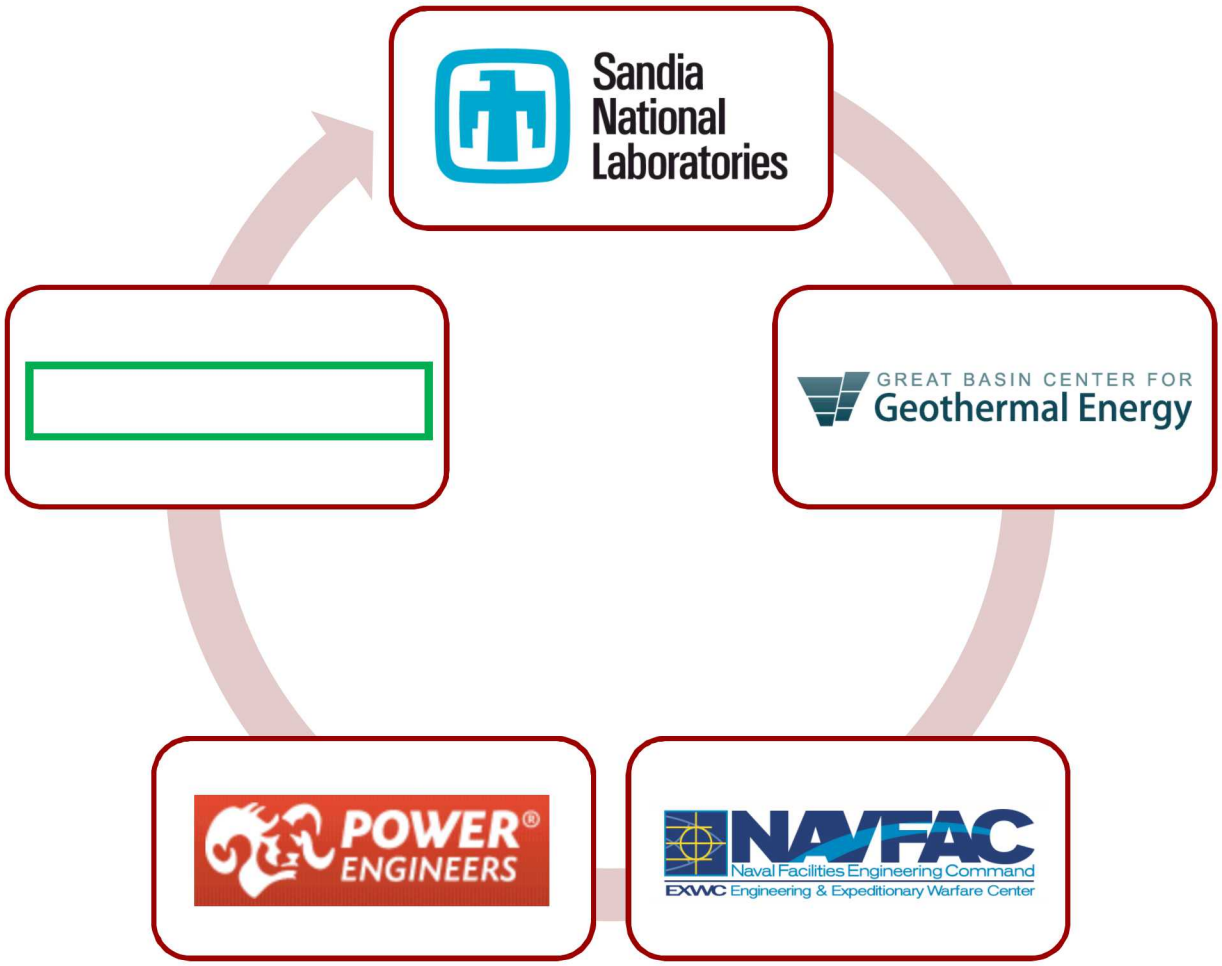
Nick Hinz[3]

Ray Arguello[4]

Kelly Blake[2]

Michael Lazaro[2]

David Meade[2]



1. Sandia National Laboratories 2. Naval Geothermal Programs Office 3. University of Nevada – Reno 4. Power Engineers 5. DOE

Project Objectives

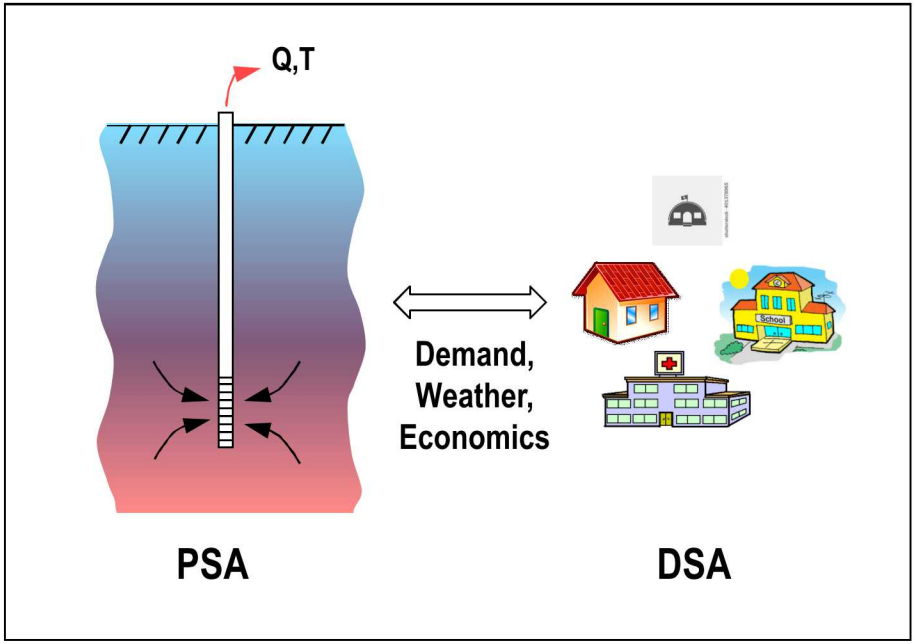
Innovation: Three-Tiered Approach

- Production Side, Demand Side, and Whole System Analyses

PSA [Below Ground]: Predicts the time dependent, long-term thermal performance as a function of flow rate

DSA [Above Ground]: Determines the cumulative heating and cooling loads and the efficiencies and losses associated with their current systems

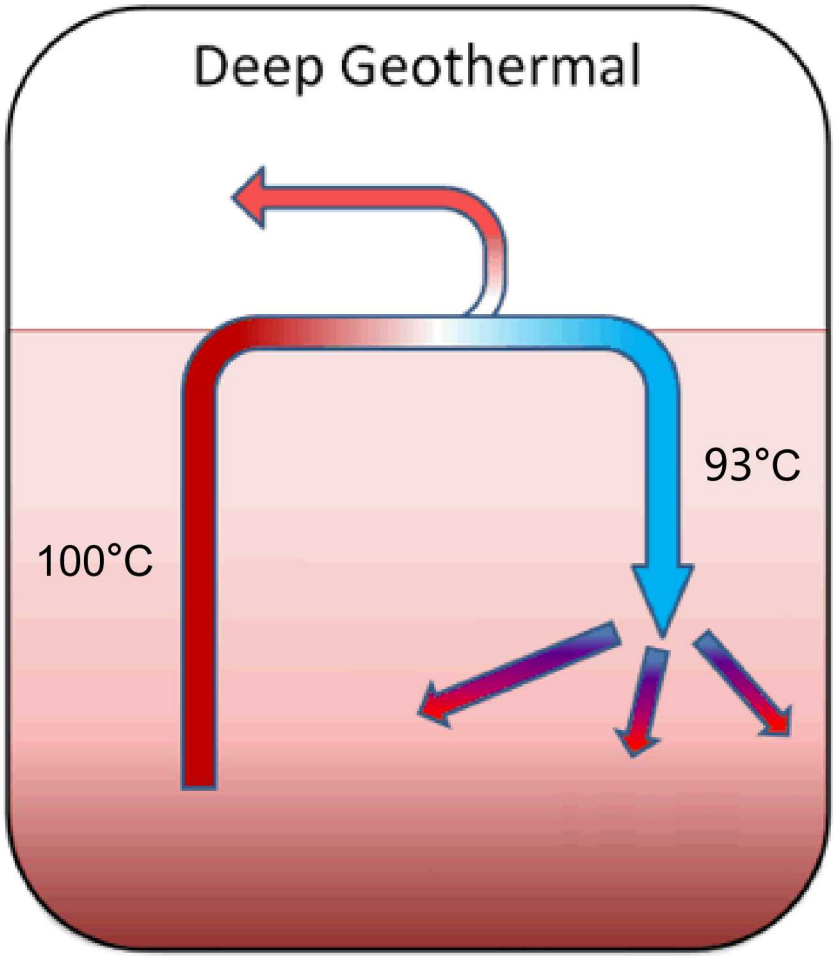
WSA: System dynamics modeling to simulate the integrated dynamic behavior between the PS and DS to identify and understand dynamic dependencies, uncertainty, and risk



The output is a comprehensive techno-economic feasibility assessment that presents Pareto optimal results for different direct-use district heating and cooling configurations that show the respective tradeoffs amongst a set of decision metrics

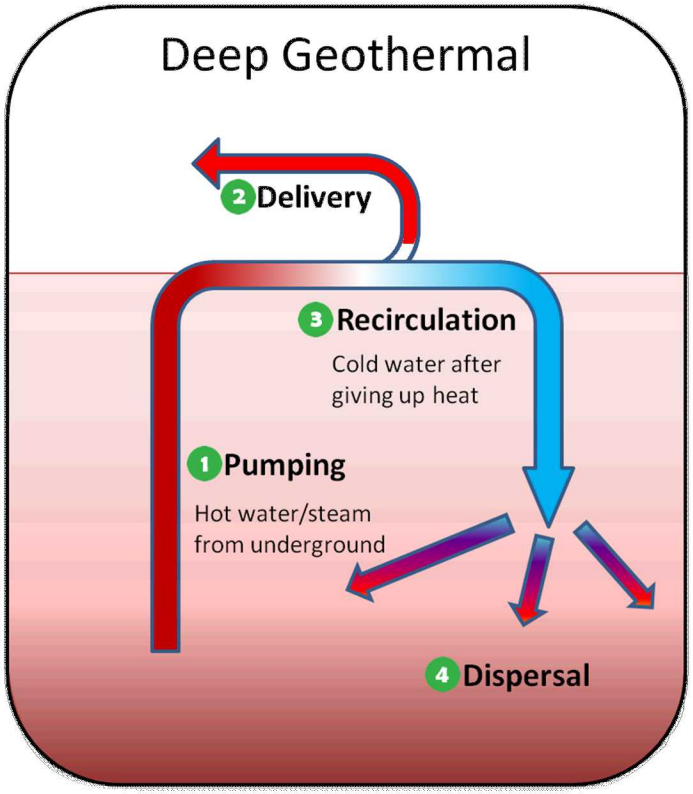
Demand Side Energy Available

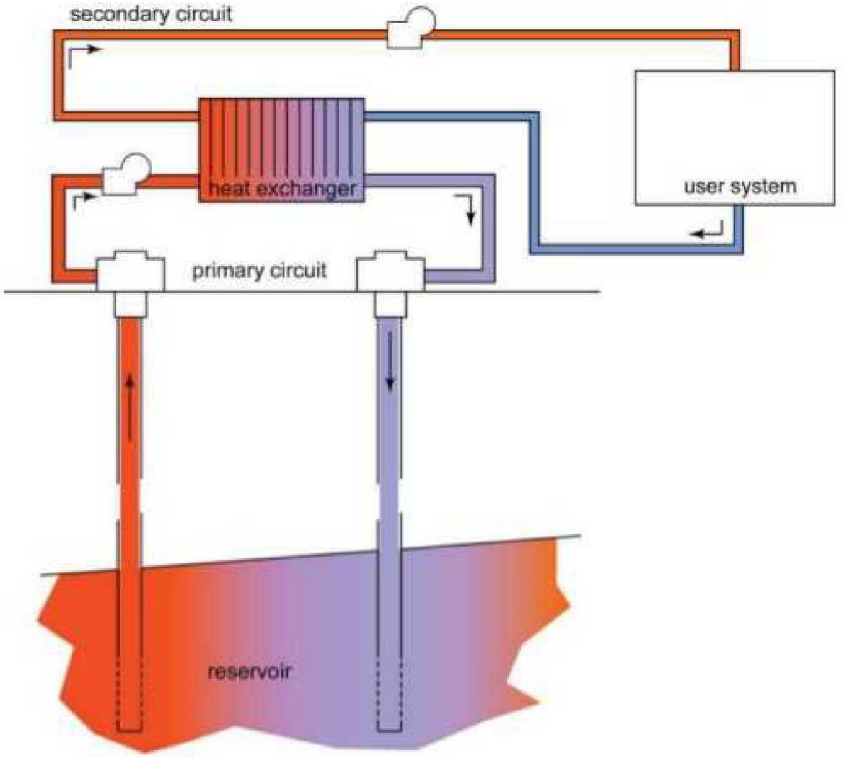
- Using gross assumptions
- Need to complete production side analysis—it is in year 1 of 2
- Assumption is geothermal fluid available is 600 GPM at 100°C
- As production side data is finalized, the amount of energy available for heating and cooling will be adjusted in the demand side model
- Assuming the reinjection temperature will be approximately 7 - 15°C lower than the temperature of the resource



Geothermal Energy Demand Side Use

GOAL: Use the geothermal resource to its maximum for heating and cooling without depleting the resource



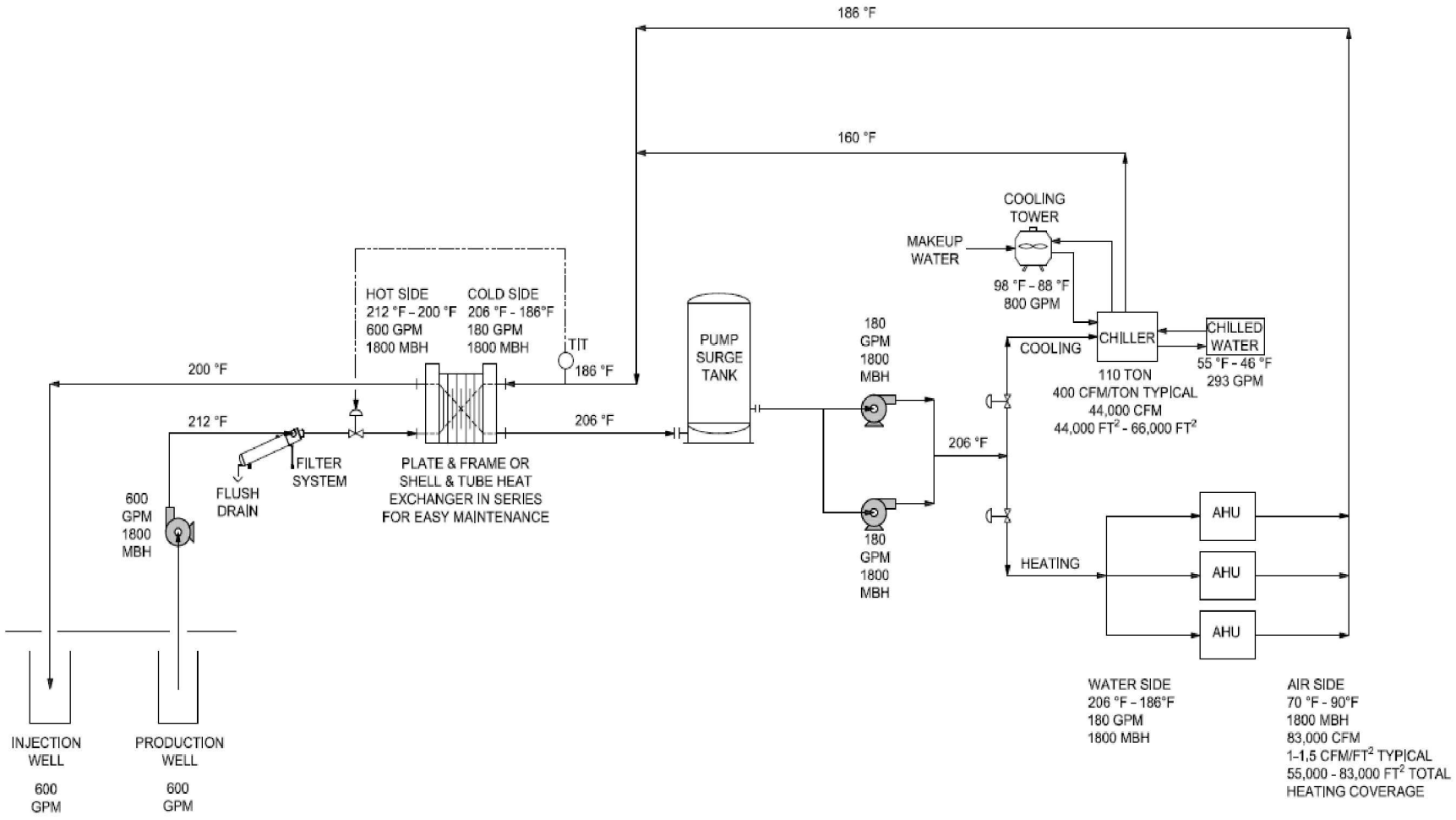


Geothermal direct use system configuration

Assumptions for Demand Side

- Goal is maximize the energy use in a cost effective manner for heating and cooling
- Well source is one mile from heat exchanger
- Injection point is two miles from heat exchanger
- Computed the total BTU available at 600 gpm at 100°C
- Reinjection in the current model is 600 gpm at 93°C
- 1,800,000 BTU/hr available—1800 MBH
- 1800 MBH is used in the Trane Trace 700 model

Overall Demand Side System Layout

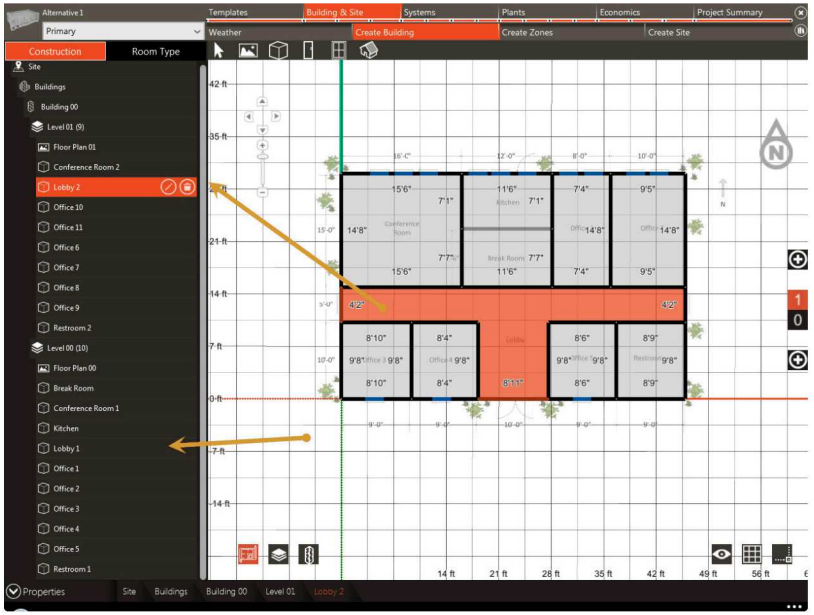


Preliminary Direct-Use System Design

Energy Model Used TRANE Software

- TRANE TRACE 700 software was selected
  - It is easily available and affordable
  - Accurate for office buildings and residential buildings
  - Easy to learn

TRACE 700
comprehensive building analysis software from Trane



Modeled Office Buildings and Housing

- Current Modeling Energy Available
  - Energy Available
    - 83,000 square feet of buildings can be heated
    - 69,000 square feet of buildings can be cooled

Hawthorne Courthouse

Modeled Office Buildings and Housing

- Need to review possible uses of the energy between the City of Hawthorne and Hawthorne Army Depot (HAD)

Typical buildings at HAD to be heated and cooled

Potential Applications

- Hawthorne: Population ~3200, Mineral County Seat
  - Hospital, K-12, county courthouse, fire station, and sheriffs office
  - Energy to heat 83,000 square feet of buildings

Potential Applications

- Hawthorne: Population ~3200, Mineral County Seat
  - Cool buildings that are not heated—simplifies controls and mechanical systems
  - Need to evaluate distance to possible well site

Potential Applications

- Hawthorne Army Depot (HAD)
  - Industrial Facility
  - Energy would be used for other than Industrial Buildings
    - Office Buildings
    - Housing on HAD for Employees
- Should heating and cooling be split among different buildings?

Technical Scope Summary

Feasibility Determined by Answering the Following:

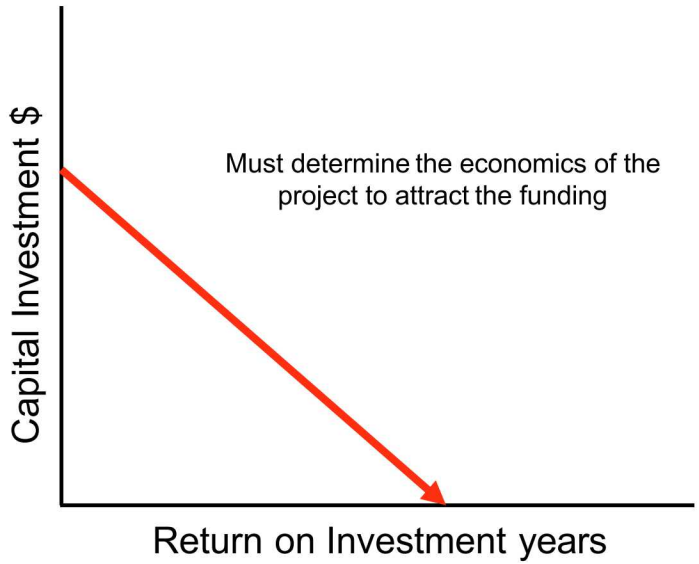
- Can the resource support more than 83,000 square feet of heating?
- Can the resource support more than 69,000 square feet of cooling?
- Should different buildings will be heated and cooled?
- What is the probable location of the extraction and injection wells?

Engineering Questions:

- Does the location of the wells affect the energy available?
- What is the ROM cost of the system?
- Does the financial model make it likely for a Public Private Partnership (P3) project?
- Does this study justify a full engineering feasibility study?
- How do system uncertainties influence the feasibility estimates and risk of development?

Decision Metrics

- The output from this project supports decision making by providing insight into the tradeoff's between multiple metrics
  - Location of wells
  - Energy resilience and security
  - Likelihood of P3
  - Capital investment
  - Return on investment
  - The project must make economic sense



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