

# GeoZone Pre-project Stakeholder Input

June 28, 2022



# Objectives for Today

Share SCP's vision for reaching 100% renewable or carbon-free energy with transition to electric vehicles.

Explain SCP's goal for maintaining power reliability - pairing solar and batteries with geothermal power.

Meet prospective private partners screened for having technical and financial capability.

Provide early stakeholder input into our community's values to inform the next stages of our work before we explore specific projects.

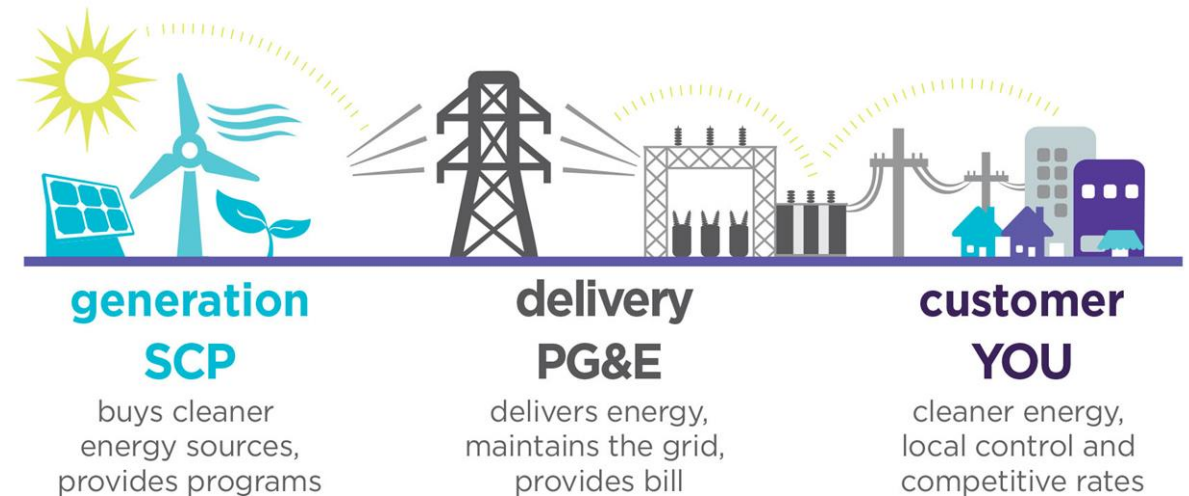
# Sonoma Clean Power

Government agency formed in 2012 to generate electricity for Sonoma and Mendocino Counties.  
Serves 87% of all customers.

Purpose is to accelerate solutions to the climate crisis.

Since 2014, have provided an option for customers to receive local renewable power every hour of every day.

Now focused on expanding 24/7 clean power service to everyone.



# From Today's Grid to Reliable Clean Power 24/7

Ending dependency on natural gas, gasoline and diesel requires massive investments in electric infrastructure.

- Transmission and Distribution
  - Power Generation – Central and Distributed
  - Energy Storage – Central and Distributed
  - Energy Efficiency
  - Flexible Loads / Demand Response
  - Conservation
- 
- The diagram illustrates the investment responsibility for various electric infrastructure components. A horizontal arrow points from the right towards the 'Transmission and Distribution' item, with the label 'PG&E' at its tail. A large right-facing curly bracket groups the remaining five items: 'Power Generation – Central and Distributed', 'Energy Storage – Central and Distributed', 'Energy Efficiency', 'Flexible Loads / Demand Response', and 'Conservation'. To the right of this bracket is the label 'SCP (and PG&E and others)'.
- PG&E
- SCP (and PG&E and others)



# From Today's Grid to Reliable Clean Power 24/7

SB 100 (DeLeon) establishes requirement to reach 100% renewable plus carbon free power by 2045. Much harder than it sounds:

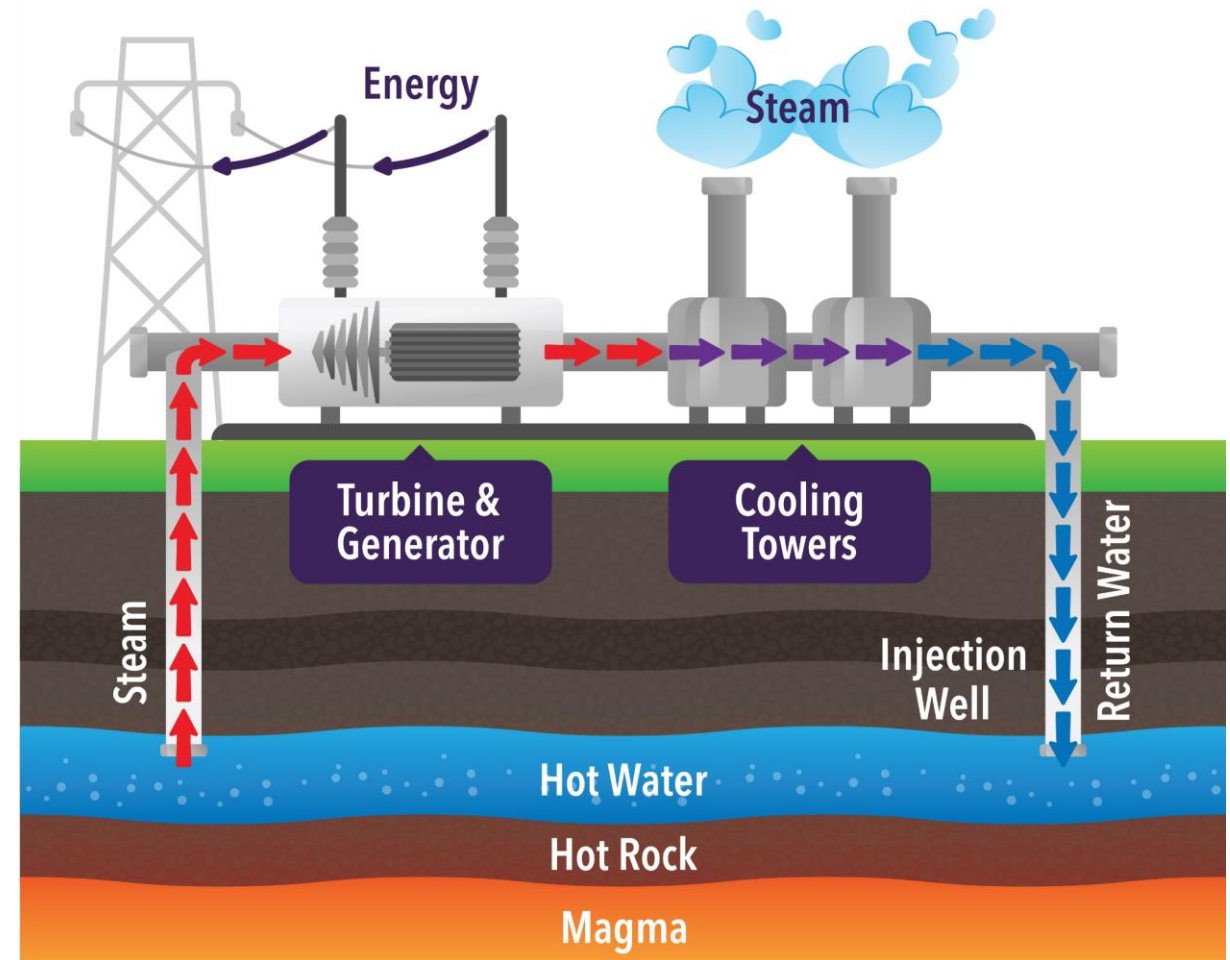
- Solar is only inexpensive source today.
- Few options for baseload renewables: biomass, offshore wind, geothermal.
- Need significant additional transmission and fire safety (e.g., undergrounding) which is driving up energy costs.
- Timeline in jeopardy from global supply of materials, war, price of copper, slow permitting.

# Geothermal Power

Earth's core provides a constantly regenerating source of heat.

Magma exists particularly close to the surface in the Clear Lake Volcanic Field underlying the GeoZone, providing elevated temperatures and heat transfer rates.

Geothermal power is generated by producing fluid through wellbores to spin a turbine.



# The Geysers

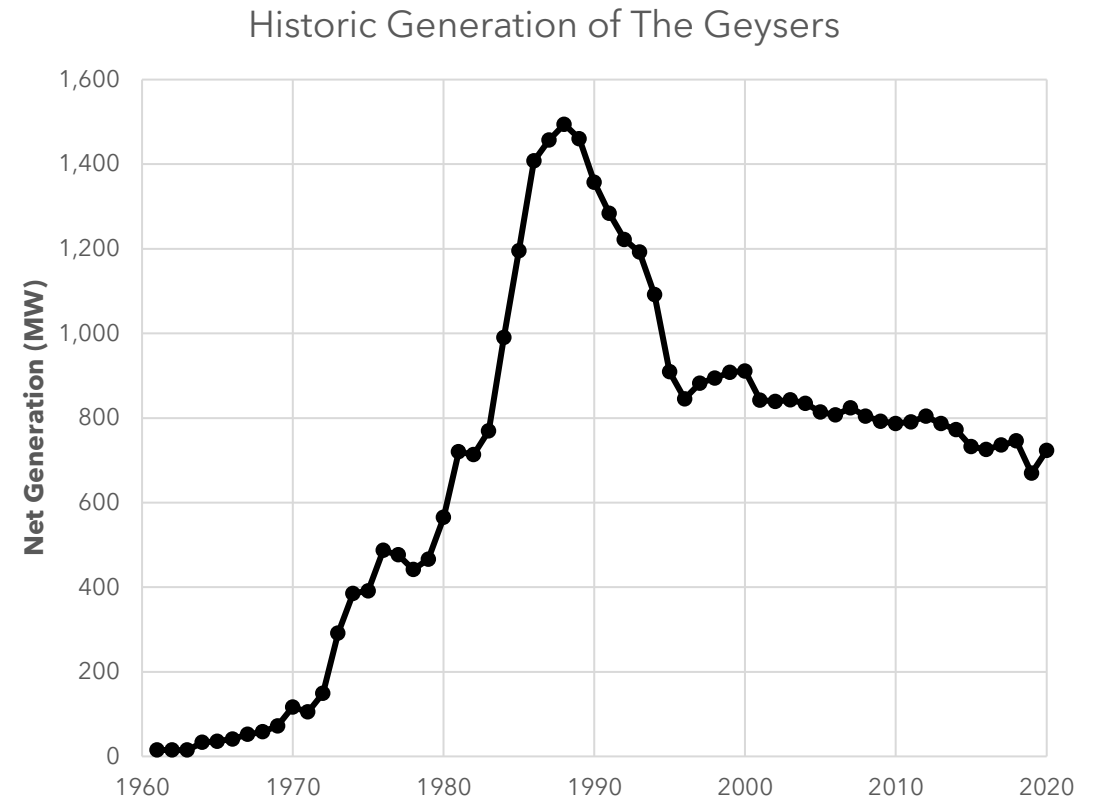
First plant installed in 1960.

Energy crisis led to massive expansion in 1980s.

Wastewater injection projects in 1997 (Clearlake) and 2003 (Santa Rosa) arrested field decline.

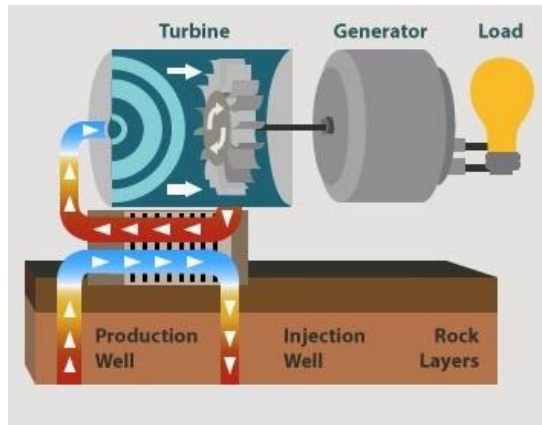
Current capacity of 700 MW and operations that prevent emissions equivalent to removing 710,000 cars from the road.

Last new geothermal facility installed in 1989.

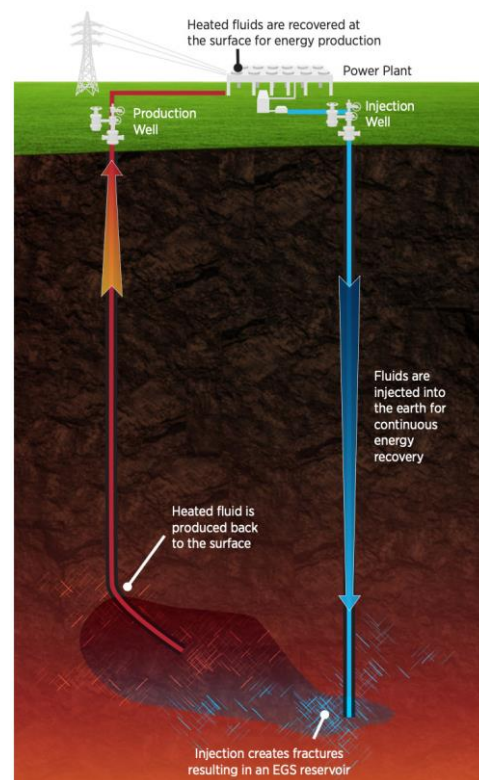


# Novel Geothermal Technologies

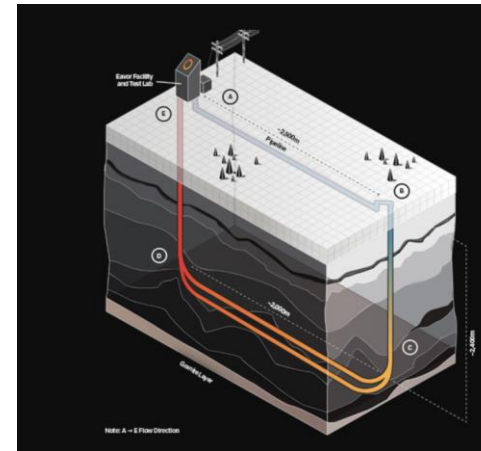
## Binary Organic Rankine Cycle (ORC)



## Enhanced/Engineered Geothermal Systems (EGS)



## Advanced Closed Loop (ACL)



## Thermal Storage





# Local Geothermal

Community input over past three years is extremely skeptical of large-scale biomass power. Offshore wind is geographically concentrated in California – mainly Humboldt and Central Coast.

Potential for more local geothermal is significant and extends beyond The Geysers.

New geothermal technologies could revive the industry with reduced environmental impacts.



# Proactive GeoZone Initiative

In advance of any orders from regulators, SCP is taking the initiative to build 500 MW of additional geothermal capacity.

Today is the very first step:

- Meet three geothermal developers to hear about their businesses.
- Provide input into community values to shape the next phase.
- Sign up to stay informed.

# **Presentations from Prospective Private Partners**

# Eavor<sup>TM</sup>

## Sonoma Clean Power GeoZone Stakeholder Engagement

June 28, 2022

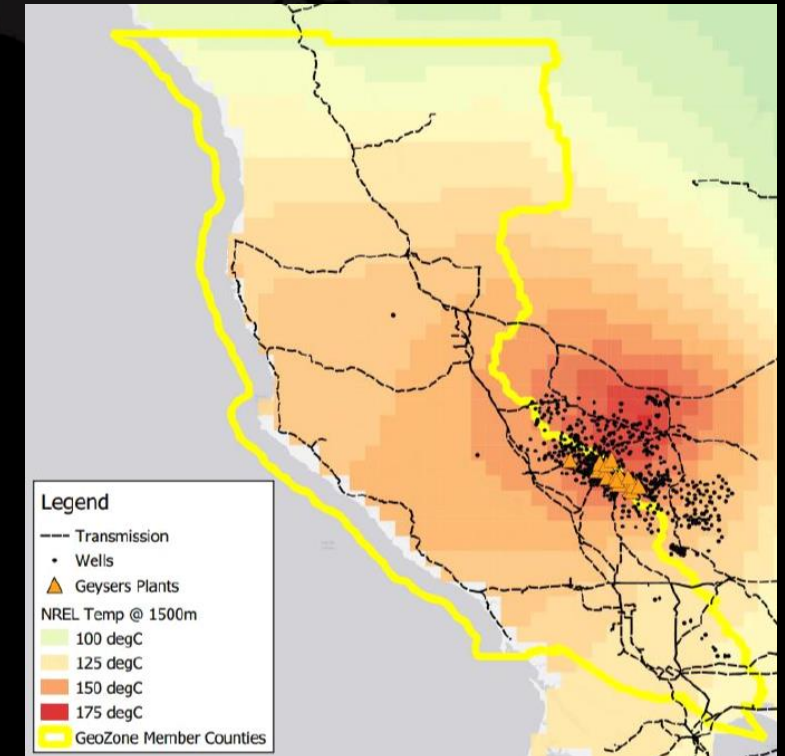




***Enabling Local Clean Energy Autonomy. Everywhere.***

# Jobs and Benefits to Local Counties

- Built with American Personnel – high paying, domestic jobs
- Construction of an Eavor-Loop™ creates up to 100 direct jobs and 300 indirect jobs
- Hardening grid and resiliency by placing supply near demand
- Lowest GHG emitting power source
- Minimal to no continual water use for operations
- Taxes coming into local jurisdictions
- Opportunity to move to energy autonomy
- Local renewable energy developer partnerships identified



# Why Eavor?

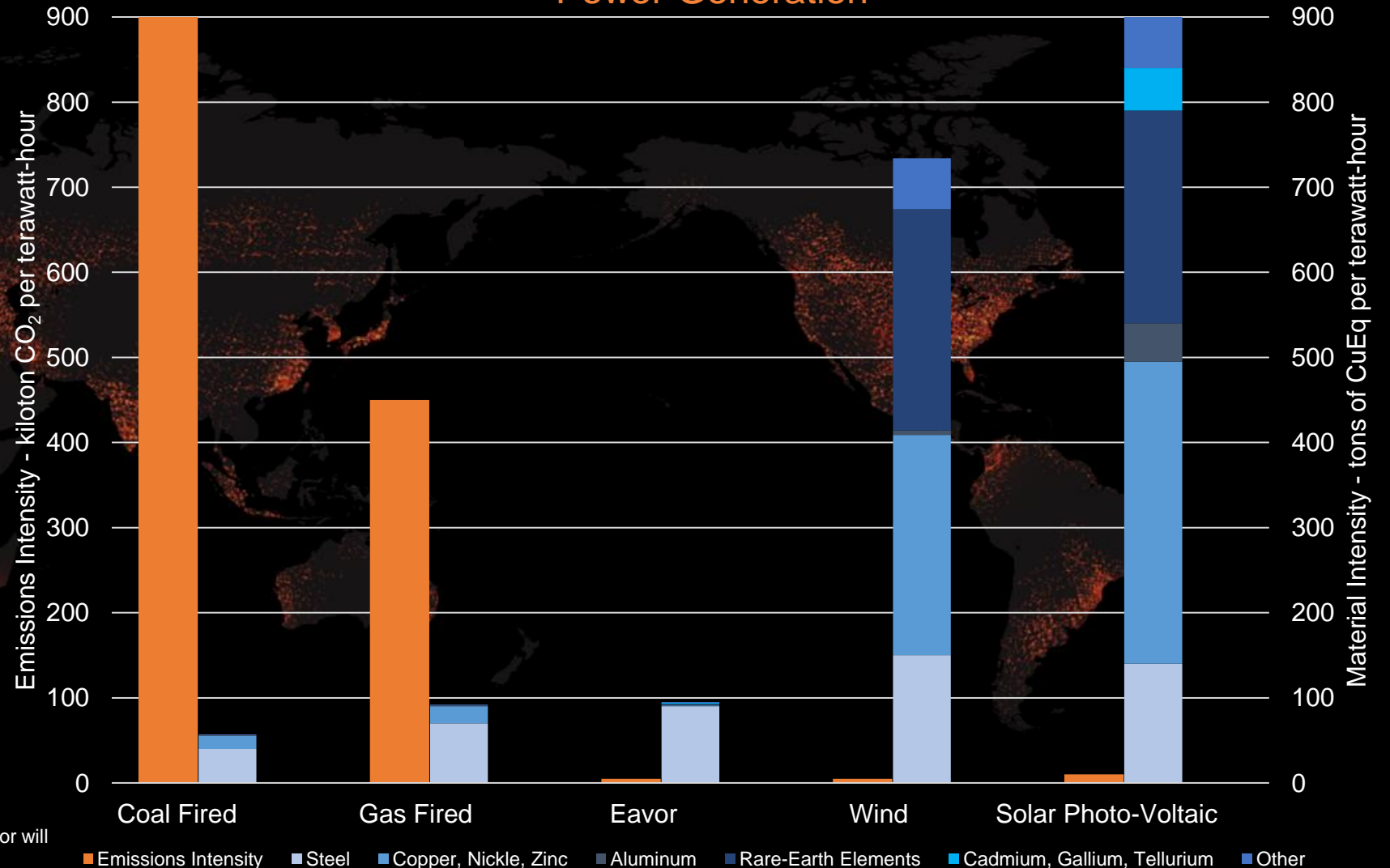
## Eavor is Clean and:

- Scalable
- Firm
- Lossless-Load-Following
- Distributable / DER
- Predictable
- Low Footprint
- Heat, Cooling & Power
- No Mining Tail

## Only Eavor Enables:

- Decarbonization of direct heat, direct cooling & electricity
- Local energy resilience, independence, security & autonomy

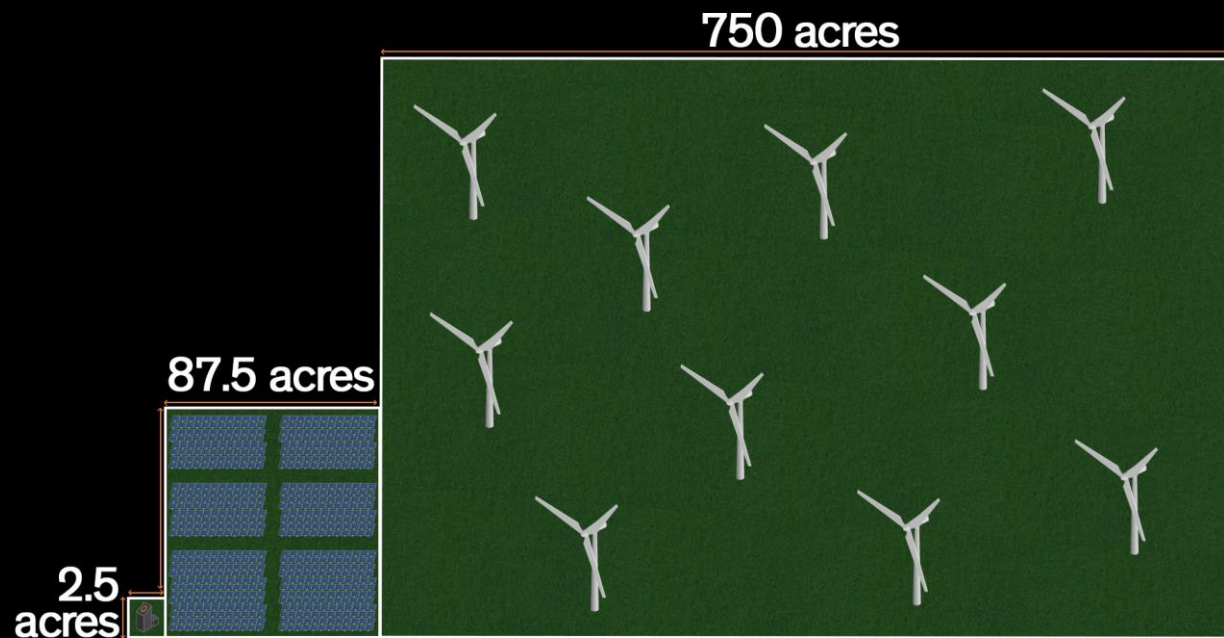
## Only Eavor Delivers Low Emissions & Materials Intensity for Power Generation



Source: McKinsey

The raw materials challenge: how the metals and mining sector will be at the core of enabling the energy transition, 2022

# Eavor-Loop™ Footprint vs Wind & Solar



	Land Use Capacity (MW <sub>peak</sub> / ha)	Capacity Factor	Land Use Generated (MW / ha)
Wind – USA	0.03 <sup>1</sup>	0.35 <sup>2</sup>	0.01
Solar – USA	0.32 <sup>3</sup>	0.29 <sup>3</sup>	0.09
Eavor-Loop™ (sedimentary, average gradient)	3.23	0.98	3.17

1. Land-Use Requirements of Modern Wind Power Plants in the United States; NREL, 2009 <https://www.nrel.gov/docs/fy09osti/45834.pdf>

2. EIA, 2021: [https://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.php?t=epmt\\_6\\_07\\_b](https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_b)

3. 2018 generation of top 35 largest US solar plants, <https://www.freeenergy.com/math/solar-pv-land-acres-hectares-miles-m118/>

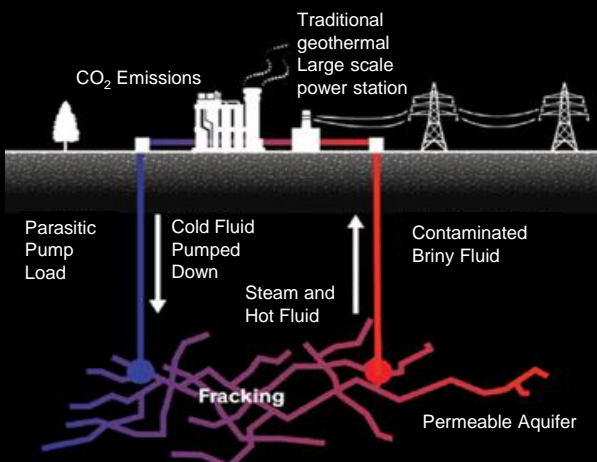
## Reliable Baseload / Firm Power

- The Eavor-Loop™ capacity factor is essentially **100%** when operating to produce baseload / firm power

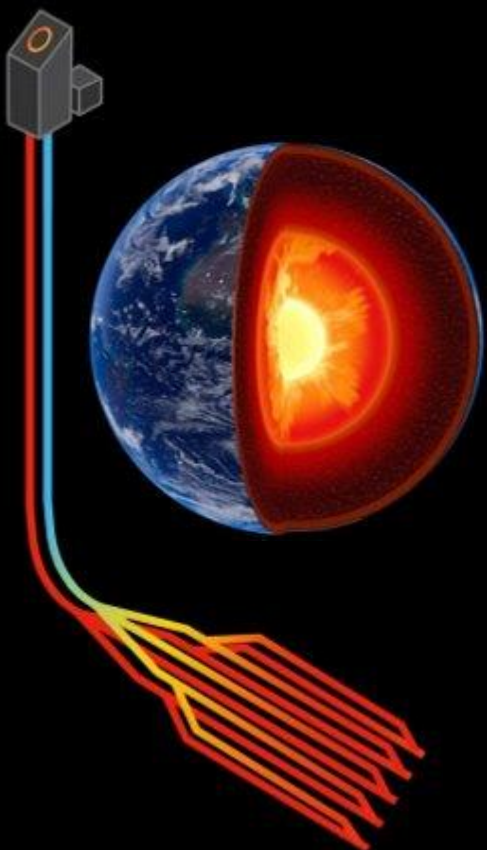
## Therefore...

- For the same surface land use, Eavor-Loop™ is expected to generate at least **35x** more power than solar and **300x** more than wind

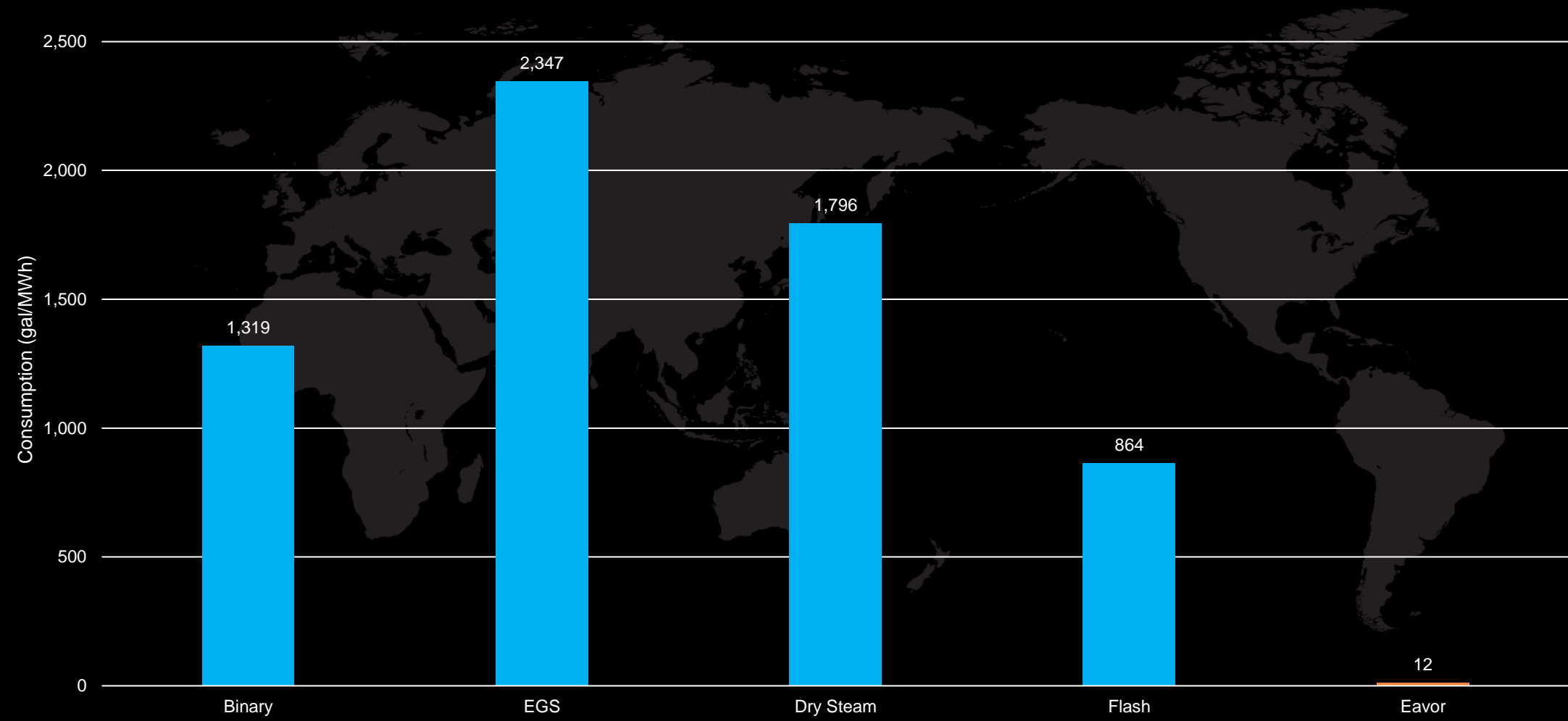
# Eavor-Loop™ vs Traditional Geothermal



Traditional Geothermal	Eavor-Loop™
Open System: water flows through reservoir, fluid exchange between system & reservoir	Closed System: Working fluid circulates in isolation from reservoir, no fluid exchange
Requires a permeable aquifer & hot convective zone	No need for permeable aquifer
Requires an electric pump to circulate brine; parasitic load	Driven by natural thermosiphon, no pumping required
Can require fracking to increase flow	No fracking required, no induced seismicity
Can produce GHGs & CO <sub>2</sub> with produced brine	No GHGs or CO <sub>2</sub>
Continuous water use & ongoing treatment required	Minimal continual water use, no production brine requiring treatment
OPEX can be greater than CAPEX over life of project	OPEX is ~80% less than traditional geothermal
Large uncertainty in thermal output	Low thermal output risk or uncertainty
Project cycle time typically 5-10+ years	Project cycle time ~2 years
Firm	Firm & lossless-load-following



# Geothermal Lifecycle Water Consumption Comparison



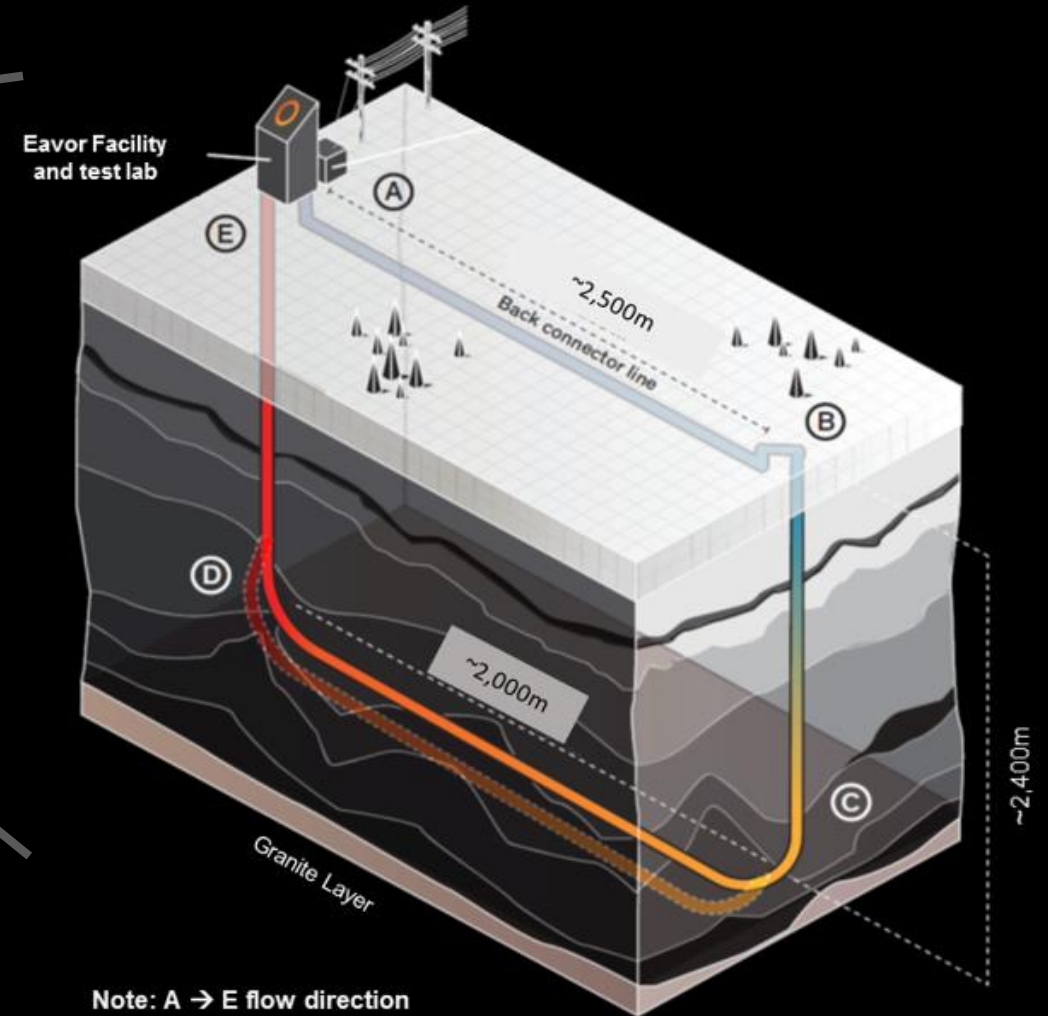
1. Non-Eavor geothermal values are averaged median data from NREL [Review of Operational Water Consumption and Withdrawal Factors for Electricity Generating Technologies \(nrel.gov\)](https://www.nrel.gov/docs/2018/04/64747main.pdf)  
2. Eavor data assuming an 8 MW<sub>e</sub> facility using Eavor-Loop™ Hard Rock geometry, including water consumption for drilling and system setup

# Eavor-Lite™ Overview



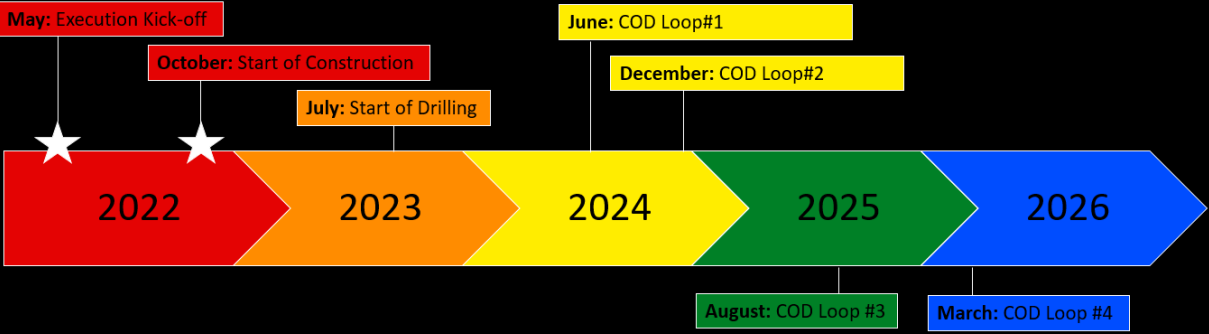
## Technical Objectives

- |  |   |
|--|---|
| 1. Drill and intersect                                 | ✓ |
| 2. Seal and pressure-test Rock-Pipe™ completion system | ✓ |
| 3. Validate thermodynamics                             | ✓ |

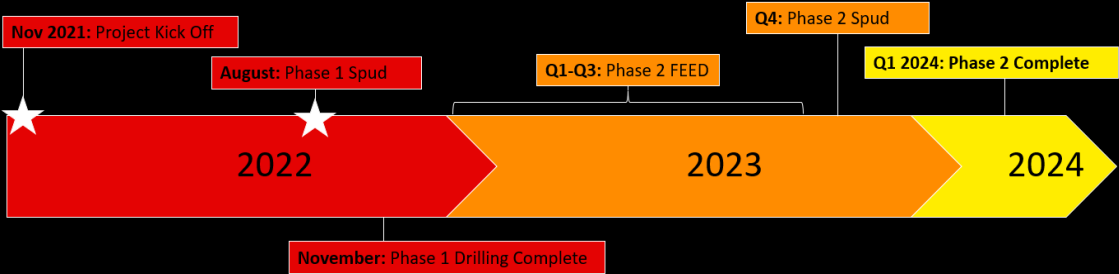
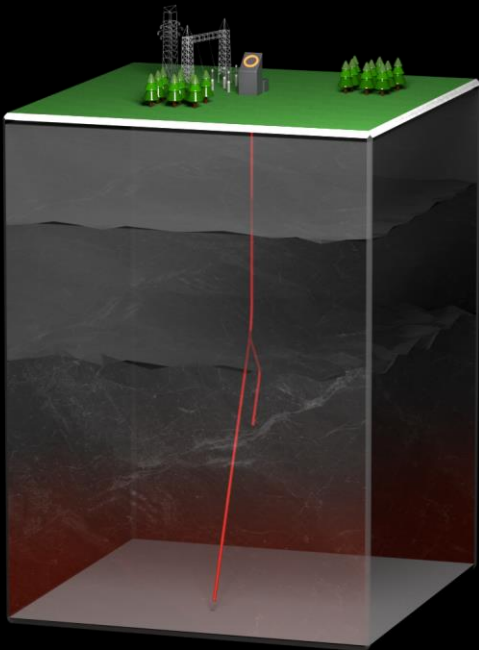


# First Commercial Projects

## Geretsried



## South Western State Phase 1



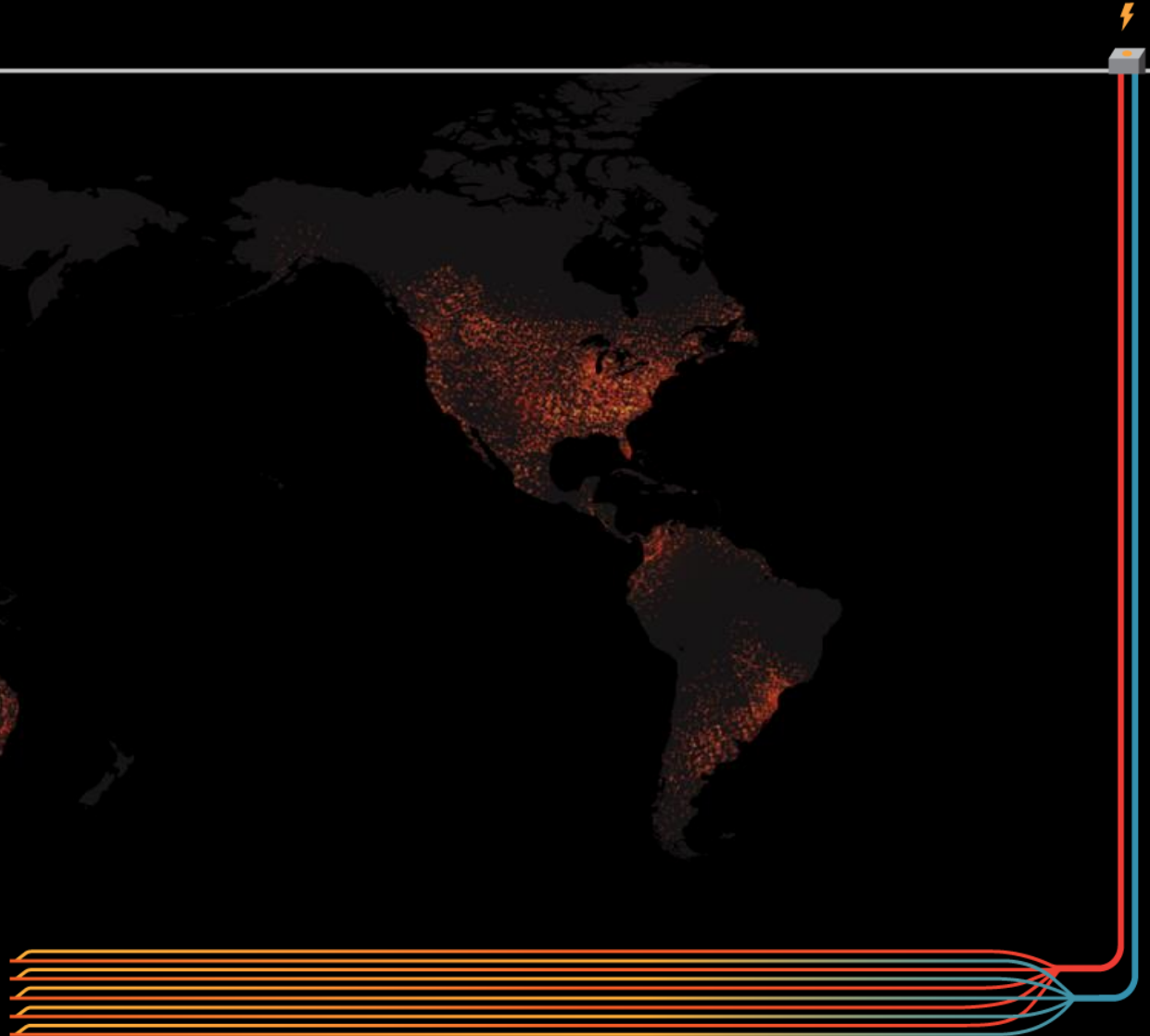
# Eavor's Technology to Unlock GeoZone Potential

Enabling Local Clean Energy Autonomy. Everywhere.

Eavor brings diverse talent and an extensive experience set with an enabling technology to:

- Provide the lowest water usage for geothermal
- No fracking
- Provide a dense, firm, energy source with limited site disturbance
- Potential for diverse regional applications not restricted to known resources
- Potential to scale up to and exceed 500 MW

# Discussion / Questions / Comments

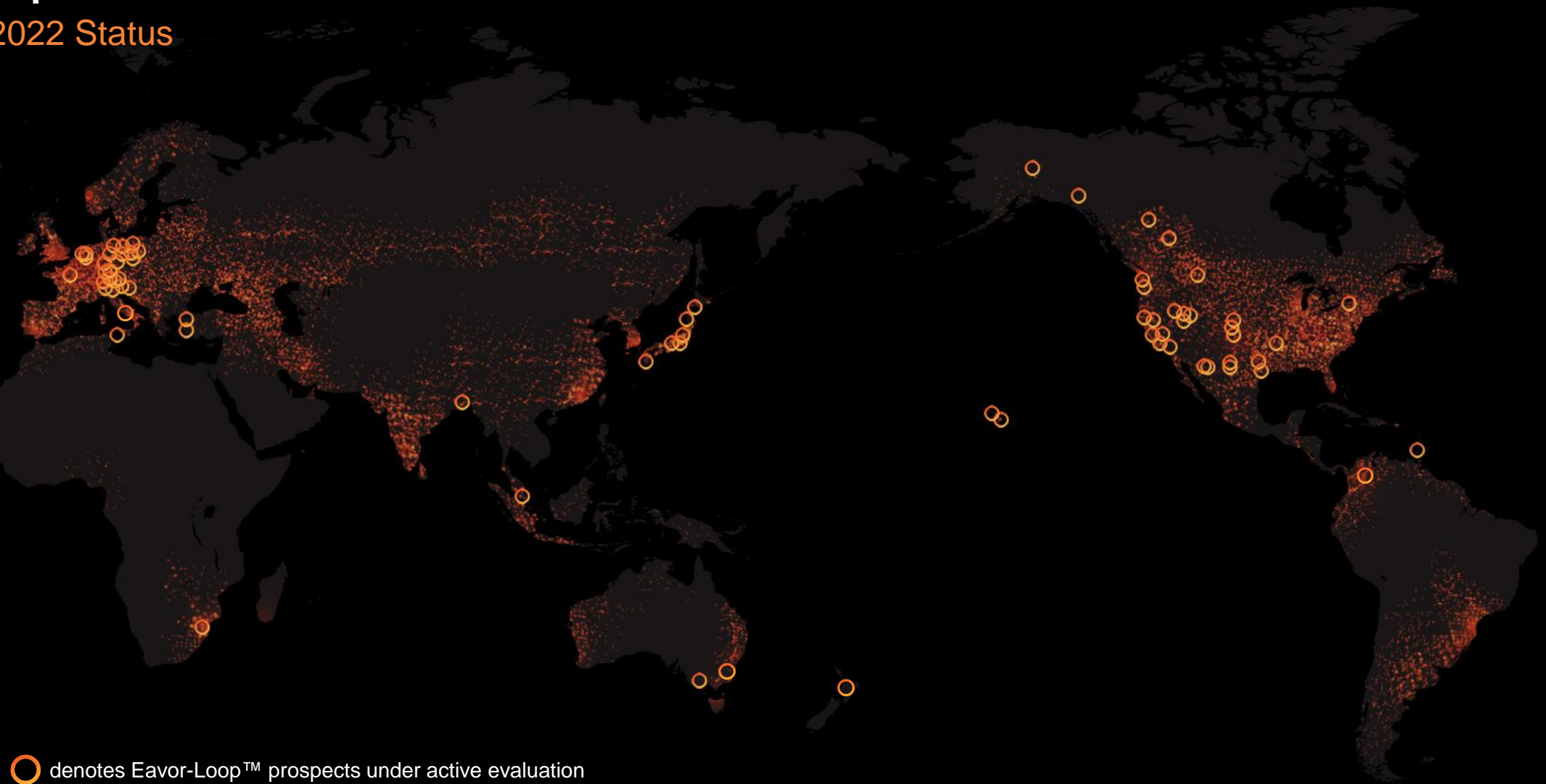




Energy For Eavor™

# Prospect Portfolio

2Q – 2022 Status



○ denotes Eavor-Loop™ prospects under active evaluation



# Sonoma Clean Power GeoZone Development Opportunity

Chevron New Energies

June 28, 2022

**the**  
**human**  **energy**  
**company**™

# Chevron New Energies

Our goal is to be a partner and neighbor of choice

Chevron's commitment is to **enable human progress** while **benefiting the populations where we work**. We protect the **environment, empower people, and get results the right way** – both environmentally & socially.

## community engagement



youth & public safety

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community outreach

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workforce development

## sustainability



water conservation

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protecting environment

## broad partnerships



academia

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industry R&D

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government policy



# Chevron New Energies

We believe the **future of energy is lower carbon**, and that energy is essential to enabling human progress.

Chevron intends to **leverage our strengths** to deliver **lower carbon energy to a growing world**.

## our objective



accelerating lower carbon solutions

## our strategy



leverage our strengths to deliver lower carbon energy

## our commitment

# \$10B

in lower carbon capital by 2028

## Grow lower carbon businesses



Renewable fuels & products



Geothermal



Offsets



Hydrogen\*



Carbon capture, utilization & storage

\* Partially grey, blue and green.

# Chevron New Energies

## Growing our geothermal businesses

**Geothermal:** build geothermal power and heat businesses that leverage enterprise strengths



### a unique energy resource

#### baseload renewable

24/7 clean electricity | not subject to weather patterns

#### high-capacity factor

nearly limitless supply

#### small surface footprint

compared to other renewables (solar, wind)



BASELOAD  
CAPITAL

### grow at scale

#### utilize our long-term geothermal experience

largest geothermal operator from 2010-16

#### leverage novel geothermal technologies

maximize utilization of the geothermal resource

#### pilots to projects

leverage a phased approach to test multiple technologies

#### leverage our experience, strategic investments, strategic geographies

knowledge, skills, technology and partnerships



# Sonoma Clean Power GeoZone Development

## Resource Potential

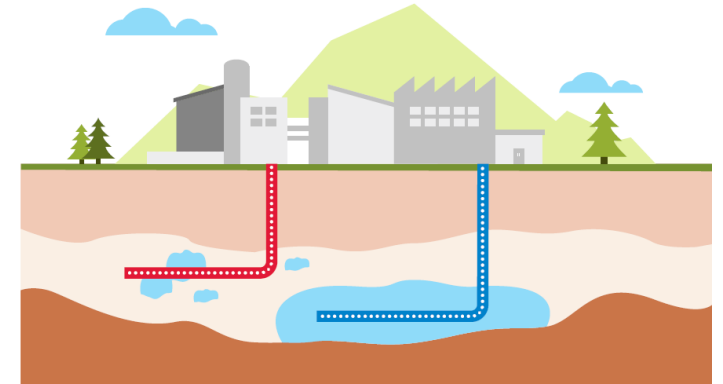
Sonoma and Mendocino counties are **rich in geothermal resource**

Total development potential ranges from **500-700 MW**, distributed below **150,000 acres**

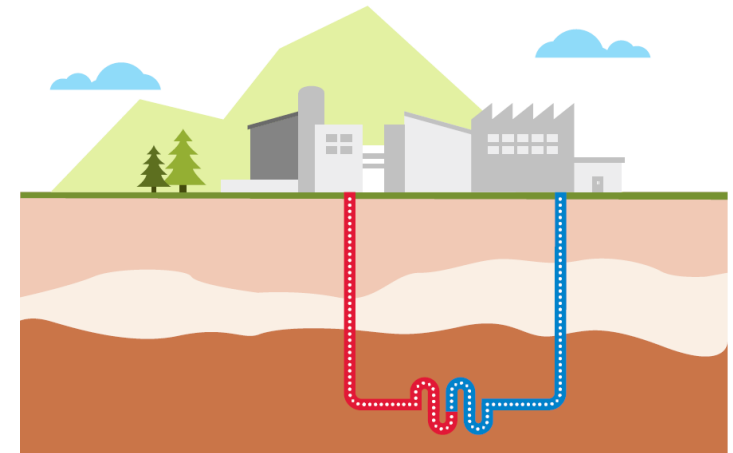
**Permitting, land access and technology considerations** will determine ultimate scale

**Phased development**, testing **combination of geothermal technologies** to safely, reliably, and cost effectively maximize resource

### Conventional / Enhanced Geothermal Systems:



### Advanced Closed Loop:



# Sonoma Clean Power GeoZone Development

## Key development considerations



### long-term scalable development

*phased pilot-to-project approach, testing multiple technologies for optimal large-scale development*



### water requirements

*minimal surface water usage & water discharge*



### minimize land usage

*small surface footprint and use of modular power generation systems*

# Sonoma Clean Power GeoZone Development

## Phased development approach



# Sonoma Clean Power GeoZone Development

## Community benefits

We work together with our community stakeholders to understand their needs and priorities as we:

- avoid or mitigate the potentially adverse impacts of our operations;
- live our commitments to environmental, health, and social performance; and
- identify and develop meaningful opportunities to support the community and contribute to their environmental, economic and social well-being.

**delivery of  
clean, reliable  
electricity**

**economic revenue**

**growth of low  
carbon energy  
sources**

**minimal water  
and land use**

**job creation**



# Open Discussion / Q&A





Cyrq Energy

*GeoZone Stakeholder Engagement*  
*June 28, 2022*



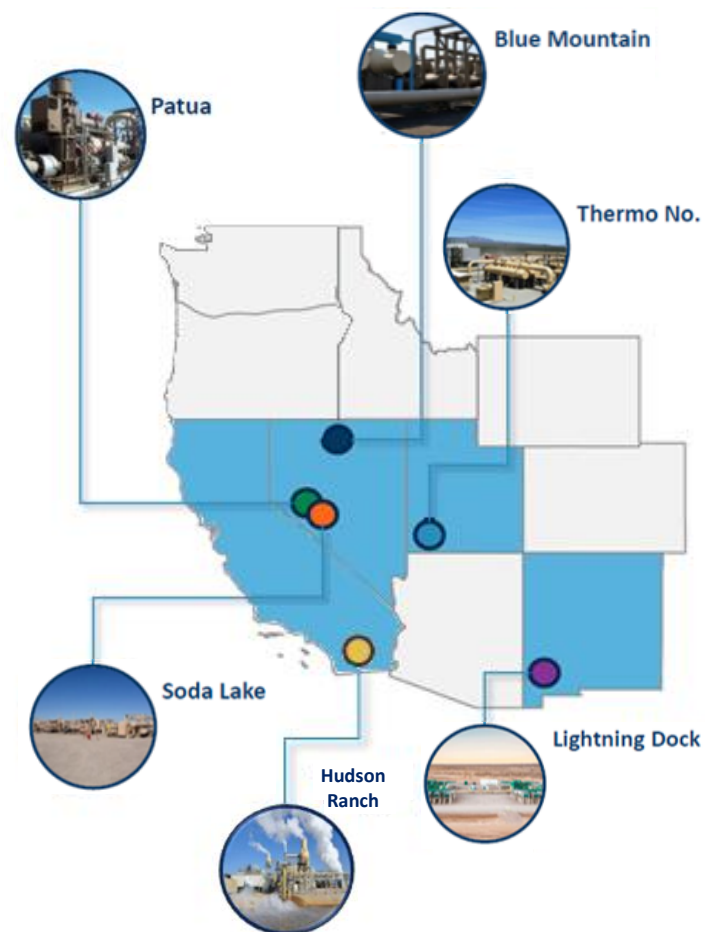
## Cyrq – Company Intro

Cyrq is the second largest privately held geothermal power producer in the U.S.

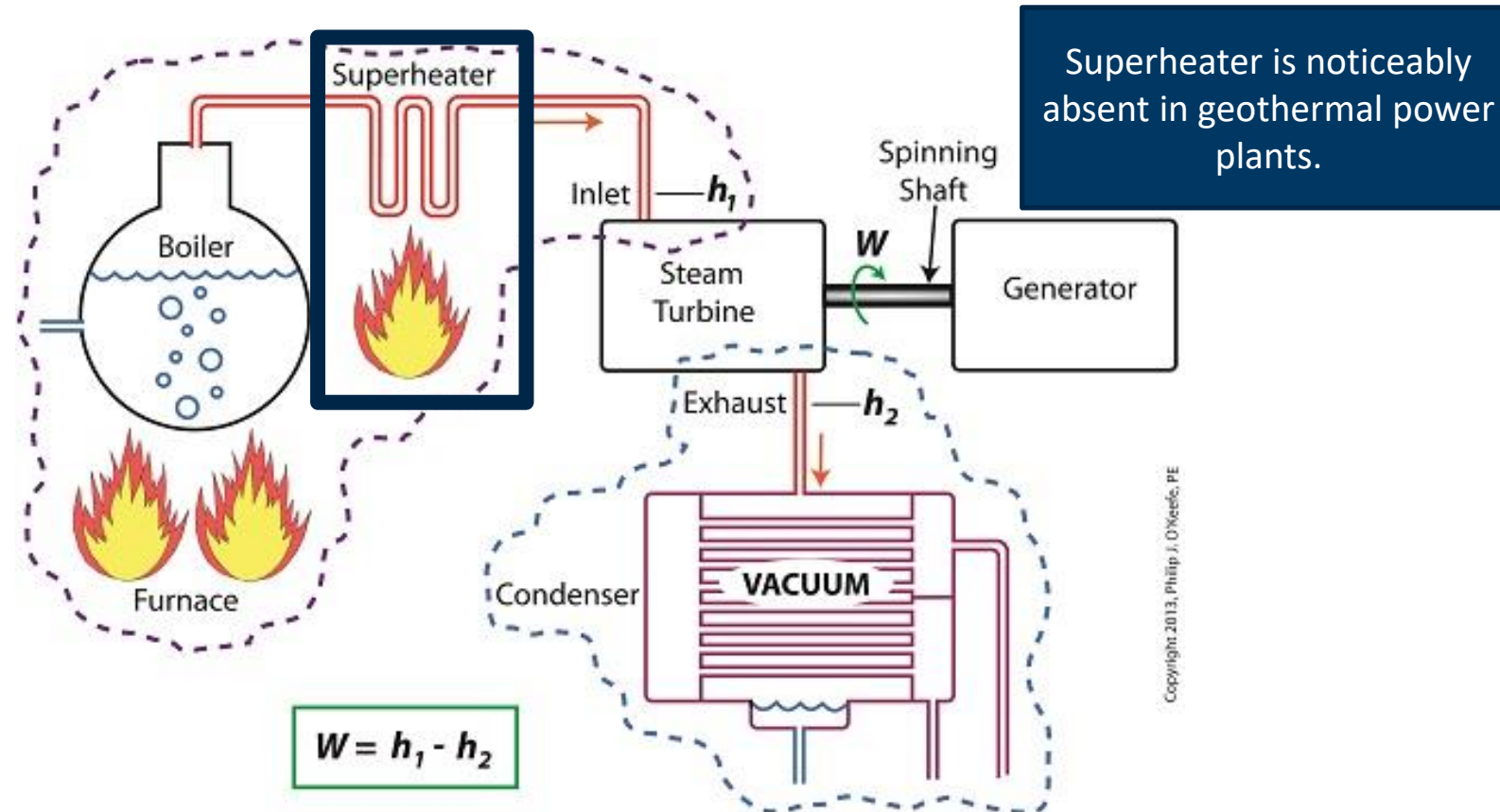
We operate a fleet of 6 power plants with a combined 186MW of capacity in Utah, New Mexico, Nevada, and California

Cyrq has a development pipeline consisting of 200MW of new generation as well as several direct use district heating projects

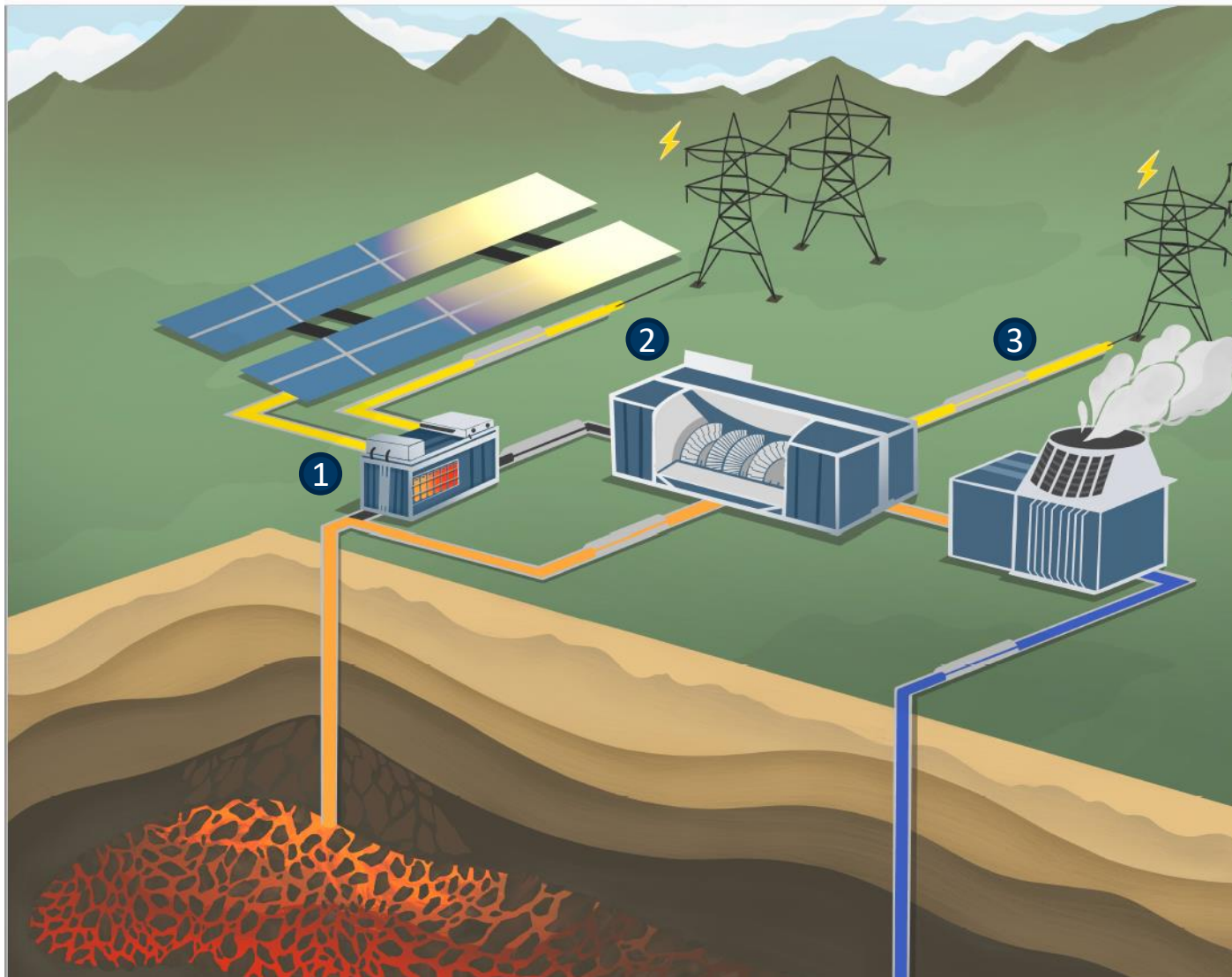
Cyrq is a portfolio company of Macquarie Asset Management (MAM), a global infrastructure fund with over \$340B in assets under management



# Steam Power Basics

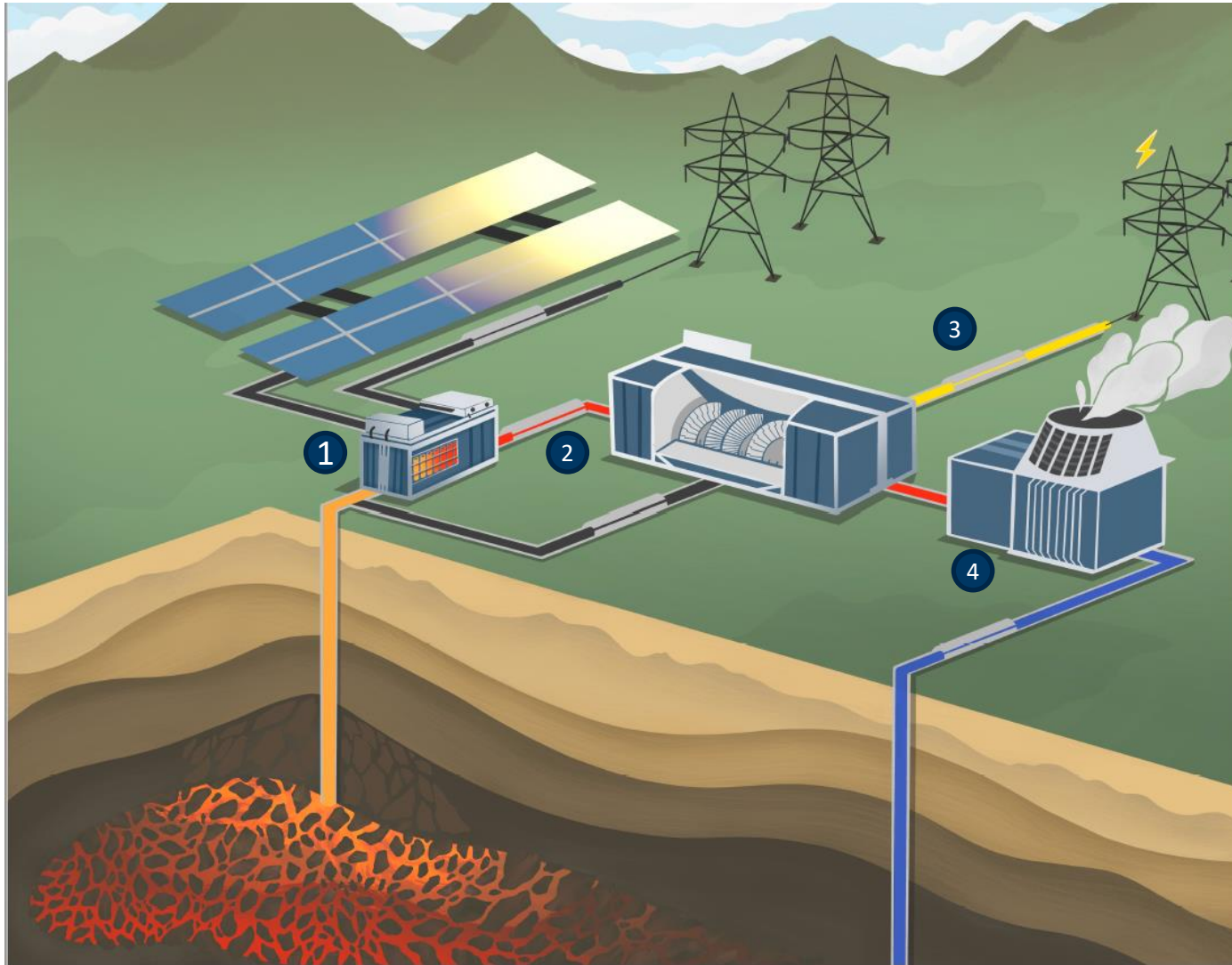


## Charging Cycle



1. TES Unit: The thermal storage is charged electrically either from the grid or behind the fence with a renewable source like PV.
2. Steam from the wellfield bypasses the TES and the plant operates as normal.
3. The amount of power sent to the grid could be modulated by both the charging and discharging systems.

## Discharging Cycle



1. TES Unit: The thermal storage acts as a superheater during discharge. Steam enters from the wellfield and is superheated either directly or through a heat transfer fluid.
2. Superheated steam enters the steam turbine.
3. Net generation increases and can potentially be variable with different levels of superheat.
4. Condenser and reinjection are not impacted.

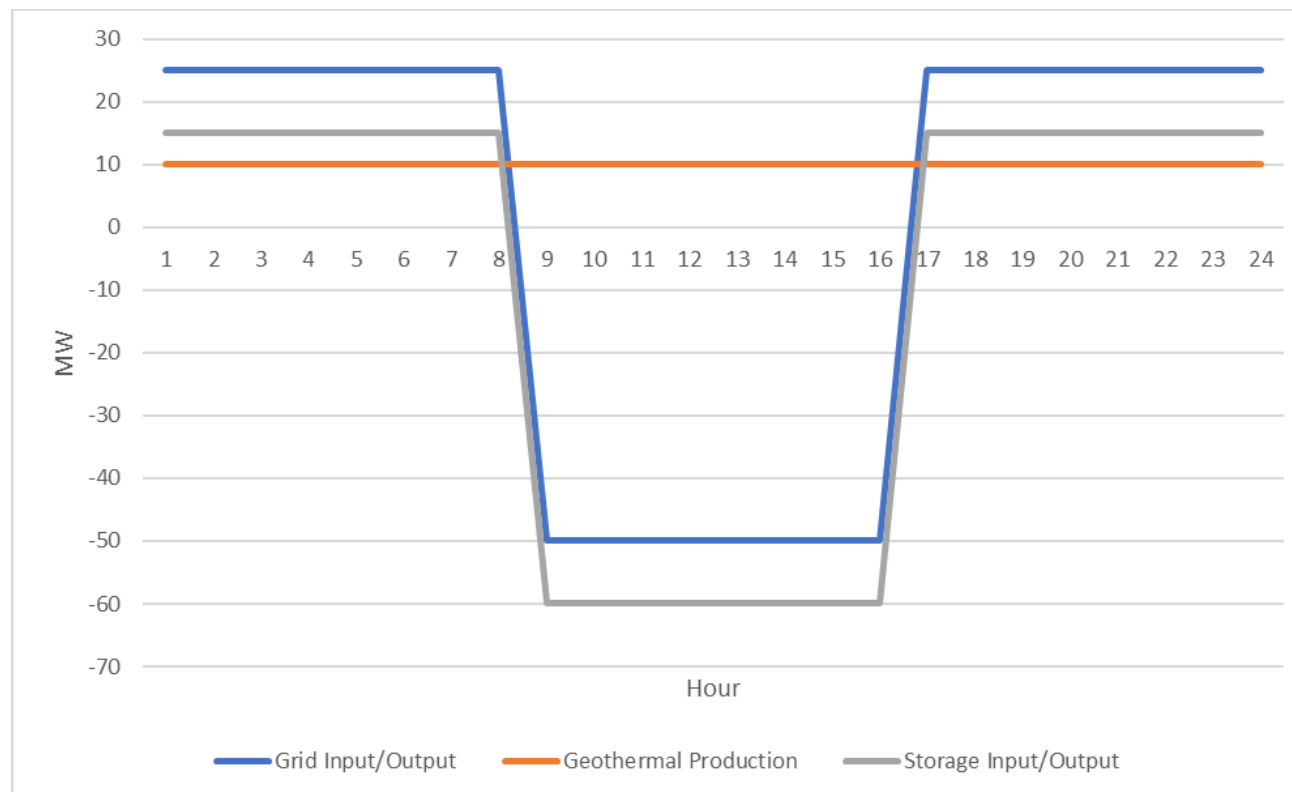
## Geysers Case Study

- Cyrq modeled its superheat system on a retired plant in the Geysers with the help of the plant's owner and turbine manufacturer.
- When the plant last operated it generated 10MW with 200,000 lbs/hr of saturated steam at 325°F.

Temperature	Gross Generation	Generation Increase from Baseline
325°F	10MW	0
500°F	16MW	6MW
850°F	21MW	11MW

110% increase in power comes with a 19% increase in cooling load.  
Overall water consumption per MWh reduced by 43% when the system is discharging.

## Geysers Case Study – Sample Operations



16 Hours per day  
discharging

8 Hours per day  
charging

40% Increase in total  
generation compared  
to baseload  
geothermal

20% Reduction in  
water consumed per  
MWh of generation

## We Can Bridge the Gap in the GeoZone



850MW Operating  
Capacity

800MW Long Duration Storage

1650MW Installed  
Capacity

## Physical Footprint – 130MWh System in Germany

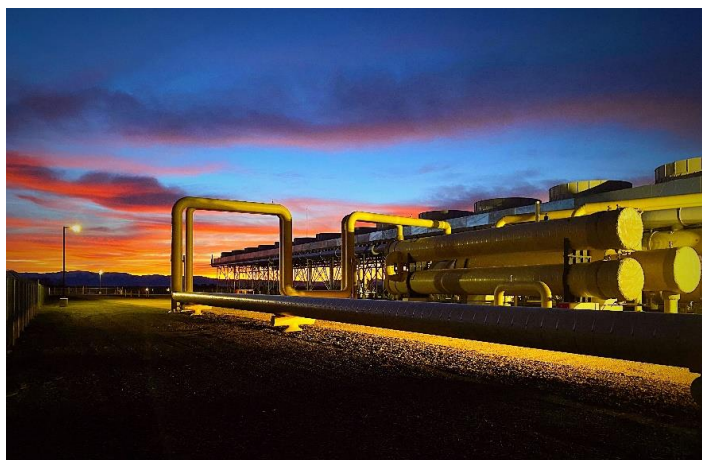


## Physical Footprint – 1/3 Acre for over 130MWh



## Cyrq's Record on Environmental Compliance

- Cyrq is proud of its environmental compliance record and believes energy production and the environment can co-exist.
- We maintain permits and agreements with multiple federal, state and local agencies and have received zero Notices of Violation. Representative agencies include:
  - US Department of the Interior – Bureau of Land Management
  - US Department of Energy
  - Nevada Department of Environmental Protection – Bureau of Air Pollution Control and the Bureau of Water Pollution Control
  - Nevada Division of Minerals
  - Utah Department of Natural Resources – Division of Water Rights
  - New Mexico Energy, Minerals and Natural Resources Department
  - California Department of Conservation – Geologic Energy Management Division
  - Imperial County Air Pollution Control District

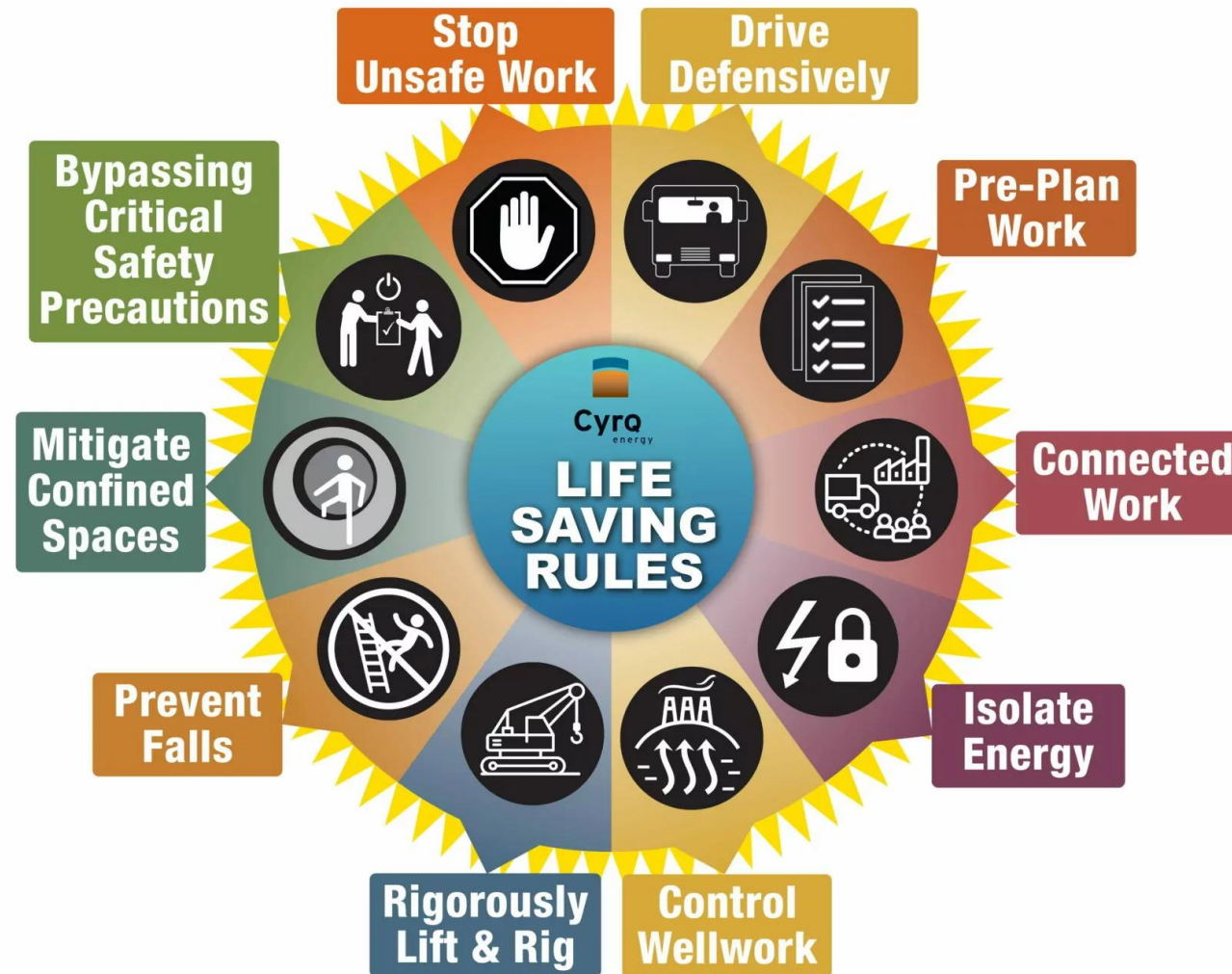


Soda Lake Power Plant, Fallon, NV



Hudson Ranch Power Plant, Imperial County, CA

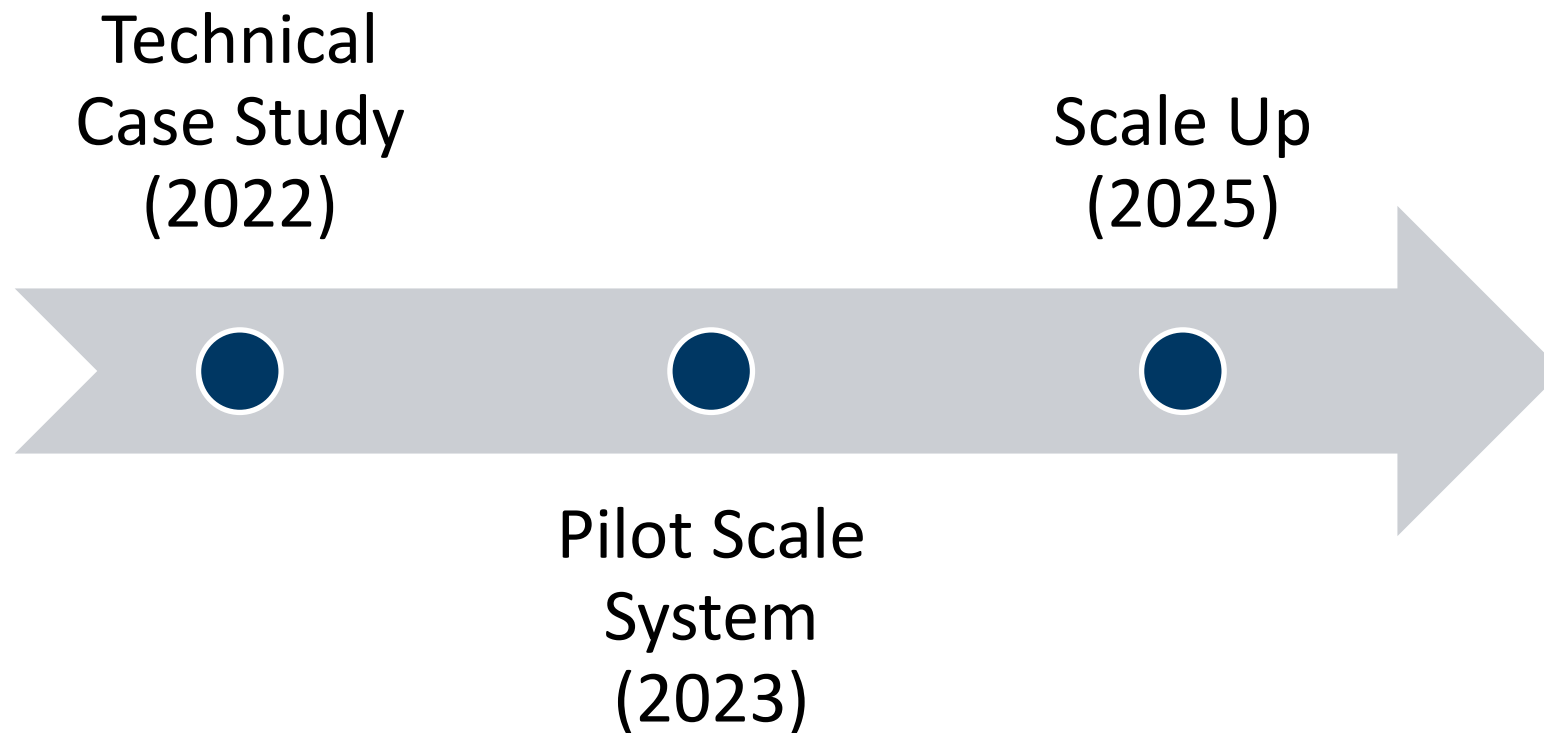
## More on Cyrq – Health and Safety





## Path Forward

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Questions?