GEOTHERMAL RISING CONFERENCE

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# Assessing the Viability of Geothermal Microgrid Deployment: A Geospatial Analysis Across the United States

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## Background

### What is a microgrid?

A microgrid consists of interconnected loads and distributed energy resources within clearly defined electrical boundaries that act as a single controllable entity with respect to the grid.[1]

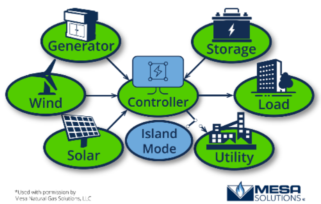



Figure 1. Microgrid components[2]

### Benefits of microgrids

- Resilience – islanded grids continue to serve critical facilities when the grid is down.
- Security – decentralized, local generation is less vulnerable to natural disasters, cyber attacks, etc.
- Grid stability – manage local supply and demand during peak hours and emergencies.
- Environmental impact – reduce reliance on fossil fuels and optimize for local consumption needs, especially in isolated communities.

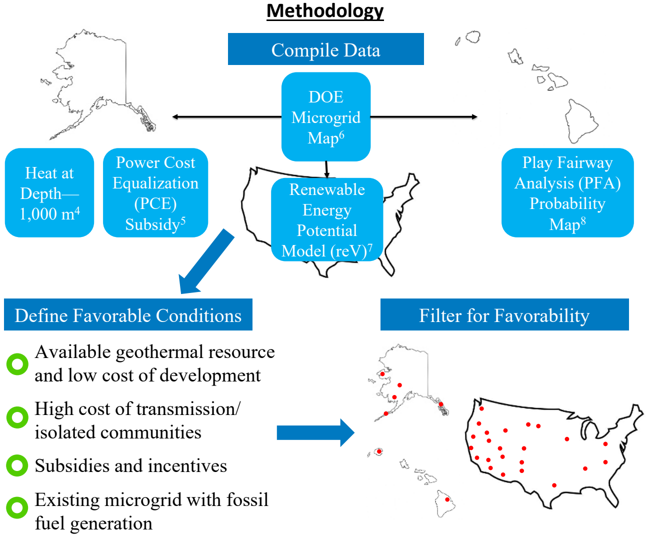
### Geothermal microgrids in the US

- The sole installation in the US is the 680-kW geothermal and diesel Chena Hot Springs microgrid (AK).[3]
- Geothermal could replace current fossil fuel-based microgrid generators, reducing reliance on volatile fuel prices and the carbon footprint.

## Analysis Goal

Leverage available data to pinpoint regions across the US that exhibit favorable conditions for the development of geothermal microgrids.

## Methodology




- Available geothermal resource and low cost of development
- High cost of transmission/ isolated communities
- Subsidies and incentives
- Existing microgrid with fossil fuel generation

## Mapping

### Legend

**Temperature [C] at 1000m[a, b, c]**
- 25 - 48
- 48 - 70
- 70 - 93
- 93 - 115
- 115 - 138
- 138 - 160
- 160 - 183
- 183 - 205
- 205 - 228
- 228 - 250

**Hawaii PFA Probability[†] [d]**
- 1
- 0

**Microgrids[a, b, c, d]**
- Geothermal, Diesel
- Microgrid with CHP and/or Fossil Fuels
- Renewable Microgrid

**reV LCOE-LCOT[a, b]**
- High Favorability[ϟ]
- Mid Favorability[ʕ]

**Alaska PCE Rate [$/kWh][c]**
- 0 - 0.13
- 0.13 - 0.26
- 0.26 - 0.39
- 0.39 - 0.52
- 0.52 - 0.65
- 0.65 - 0.78

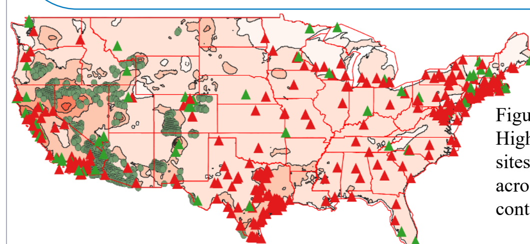


Figure 2a. Highly favorable sites and microgrids across the conterminous US.

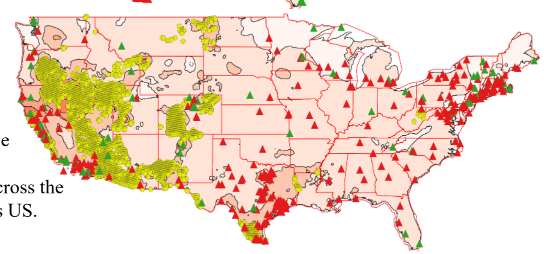


Figure 2b. Mid-favorable sites and microgrids across the conterminous US.

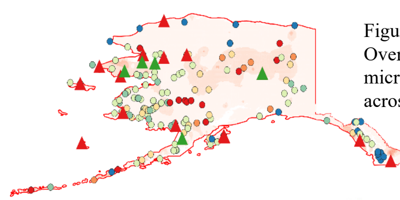


Figure 2c. Overlay of PCE subsidy rates, microgrids, and temperature across Alaska.

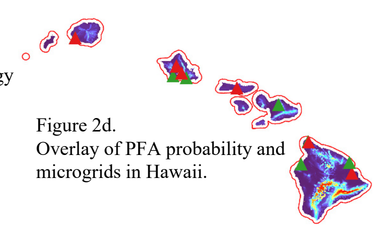


Figure 2d. Overlay of PFA probability and microgrids in Hawaii.

[ϟ] 1st quartile levelized cost of energy (LCOE) and 3rd quartile levelized cost of transmission (LCOT).
[ʕ] 2nd quartile LCOE and LCOT.
[†] Relative probability of heat, permeability, and fluid.

## Discussion

### Favorable Regions

- Conterminous US
  - reV calculates location-specific costs of geothermal development and applies geographic exclusion zones, indicating numerous western regions with low development costs and avoiding high transmission costs.
  - Many highly favorable zones already contain microgrids with combined heat and power (CHP) and/or fossil fuel generators.
- Alaska
  - Many isolated Alaskan communities are reliant on imported diesel for electricity and depend on PCE subsidies to bring down electricity costs.
  - Localized, reliable geothermal generation would reduce subsidy costs, reliance on a volatile fuel market, and carbon emissions.
- Hawaii
  - PFA reveals several regions with high probability of a viable geothermal resource, although there is not significant overlap with existing microgrids.

### Favorable Policy

- Microgrid friendly
  - e.g., California's Microgrid Incentive Program.[9]
- Geothermal electric friendly
  - 30 states + D.C. have financial incentives.
- Fossil fuel deterrent policies
  - 18 states with clean energy standards or zero-emission goals.

### Limitations

- Resource potential estimations have significant uncertainty.
- Lack of subsurface data around isolated communities where microgrids may have largest impact.
- reV assumes development of utility-scale geothermal, which does not always match the optimal microgrid for a community.

### Future Considerations

- Perform case study impact analyses considering economic, environmental, and social benefits of eliminating subsidies, fuel storage and system upgrades, avoided heating costs, carbon taxes & policy incentives, and avoided fuel spills.
- Analyze costs associated with direct heat applications.
- Consider how the size of existing microgrids and target communities impacts favorability.

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