GATES: A Geothermal Acceptance Tracking and Evaluation System Using Multi-Source Social Sensing

Mapping where and when Americans search for, post about and read about geothermal energy, 2019–2026

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01 WHAT IS THIS STUDY?

Geothermal energy can heat homes and generate electricity around the clock, but a project is built only where the **public accepts it**. Surveys measure acceptance slowly and seldom show where it differs. We built **GATES**, a system that tracks public awareness and acceptance of geothermal energy across U.S. states from **web searches, social media posts and news**. It answers three questions:

WHERE
Which states pay attention, and to which kind of geothermal?

WHEN
When does attention rise, and has next-generation geothermal arrived?

WHAT
Do people who post support it, and what worries them?

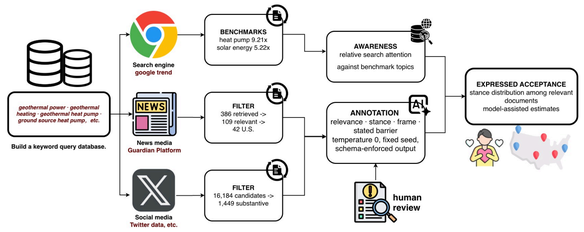
MAIN FINDING
"Geothermal" is two topics with two geographies: home heating in the cold Midwest and Northeast, power in the West and South.

02 DATA AND METHODS

Search. Google Trends by state and week, 2019 to Oct 2026

Social. 16,184 geotagged U.S. posts; 1,314 relevant

News. Two U.S. layers and 385 Guardian full texts



One keyword database feeds three channels. Each search term and text label is checked before a map or trend is read from it.

1 Map by state
Mean search interest in 48 conterminous states, 2019–2025; posts counted by state (5 or more per state and year).

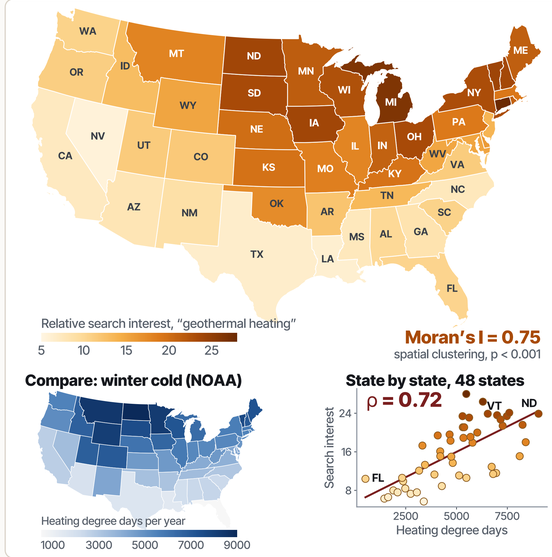
2 Test spatial structure
Spearman ρ with NOAA heating degree days; Global and Local Moran's I with queen contiguity.

3 Check every term
Three repeat pulls must agree (ρ ≥ 0.90); a site name must point to its home state.

4 Label text with two models
Two local language models label stance, frame and barrier in each post and article.

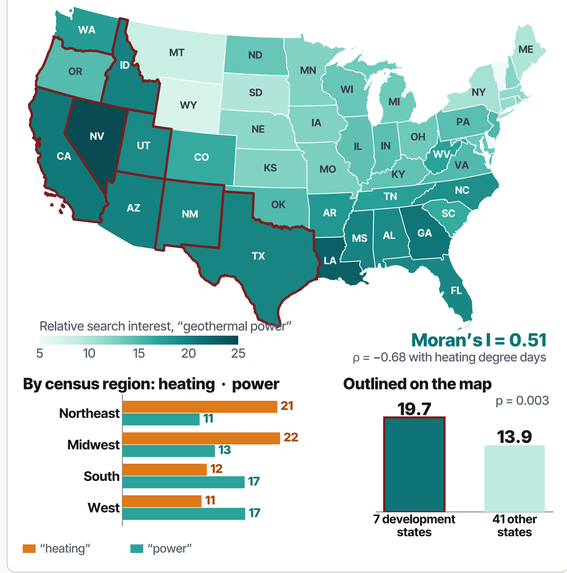
03 SPATIAL ANALYSIS Where is the attention?

A Heating searches follow the cold — SEARCH



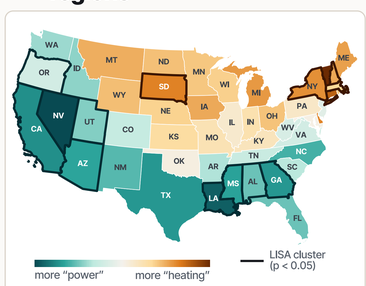
States with colder winters search more for **"geothermal heating"** (ρ = 0.72). Interest clusters in the Midwest and Northeast as strongly as climate does: **homeowners** type this term.

B Power searches follow the resource — SEARCH



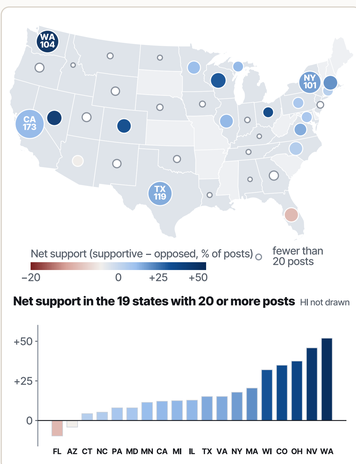
"Geothermal power" reverses the map: interest is highest in the West and South, and in the **7 states with geothermal development** (19.7 against 13.9 elsewhere).

C Two publics, two regions — SEARCH



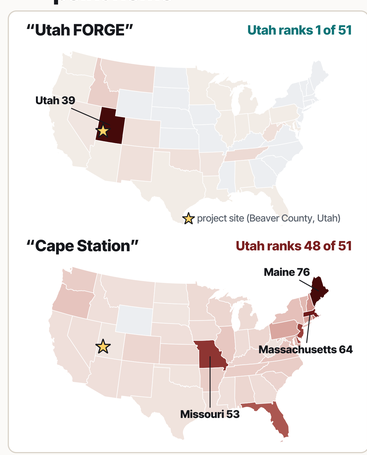
Local Moran's I finds a **heating cluster** in the Northeast and a **power cluster** from California to Georgia. The broad term "geothermal energy" has no spatial pattern.

D Posts lean supportive in most states — SOCIAL



Among 1,176 relevant geotagged posts (2021–2022), supportive posts outnumber opposed posts in **17 of 19 states**; Washington and Nevada lead.

E A site name must point home — SEARCH



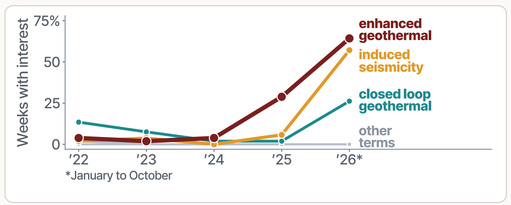
"Utah FORGE" is searched most in Utah. "Cape Station", also a Utah project, is searched most in Maine: the name matches other places, so we do not read it as geothermal attention.

04 TIME AND TEXT RESULTS



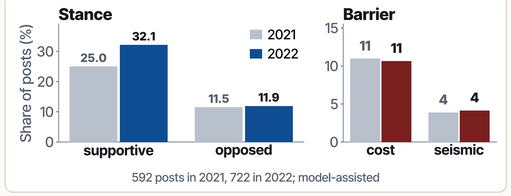
Heating terms peak in winter with heating demand. Broad terms fall every summer with school subjects such as photosynthesis: **students** type these.

F Next-generation terms arrive — SEARCH



"Enhanced geothermal" had nonzero interest in **64%** of 2026 weeks, against 2–4% in 2022–2024.

G Support rises; cost is the barrier — SOCIAL



592 posts in 2021, 722 in 2022; model-assisted

Support rose from **25.0% to 32.1%**. Cost is named 2.5–2.8 times as often as earthquakes.

POSTS AND NEWS
ρ 0.66
U.S. posts move with U.S. newspaper coverage; search moves with neither

NEWS RETRIEVAL
104 / 385
Guardian articles match a geothermal query but never use the word

05 TAKEAWAYS

1. **Geothermal has two publics with two geographies:** heating in the cold North (Moran's I = 0.75), power in the West and South.
2. **Next-generation geothermal reached search** in 2025–2026, but a site name needs a map check before it is used.
3. **Posts lean supportive**, and people name cost, not earthquakes, as the barrier.

Project website
rayford295.github.io/geothermal-awareness

LIMITS Search interest is relative, not a count of people. Text labels are model-assisted; human double coding is in progress. Social data end in 2022 and state post counts are small.

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