

Geothermal 101

The Essentials of Geothermal

Mimi Egg
Executive VP of Marketing



Our Beginnings in the World of Geothermal

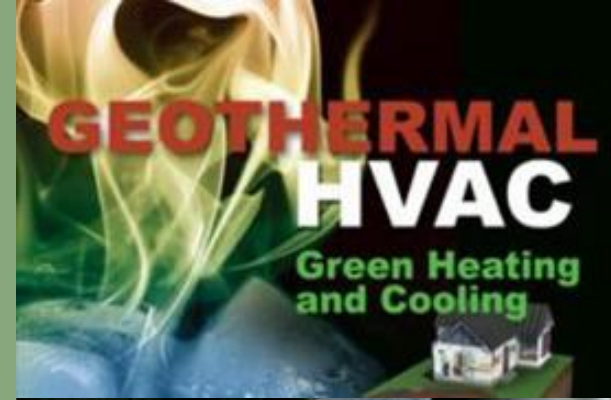
The trades are a multigenerational passion for the Egg family. Raised on a Route 66 ranch, Egg Geo President Jay Egg developed an early foundation in mechanical craftsmanship, building his first lawn mower at age ten, then rebuilding his grandmother's Dodge 318 V8 1964 Station Wagon at twelve years old .

After four years as a U.S. Navy nuclear power engineer, he applied his hands-on experience across various trades before founding his own HVAC company in St. Petersburg, Florida.



Mimi grew up with the geothermal industry as a core part of her family's foundation, first learning about the technology in 2010, when Jay was approached by McGraw Hill to write “Geothermal HVAC Green Heating and Cooling”.

She formally entered the field by stepping into the role of Social Media Marketing Head, then became the Executive VP of Marketing at Egg Geo. Additionally, Mimi is pleased to write for industry news and media leaders, such as PHCPro, AHCR News, The Driller, and many other publications.



Energy Equity

The principle that all individuals and communities, regardless of race, income, or geography, should have access to reliable, affordable, and clean energy.

Procedural

Ensuring that frontline communities have a seat at the decision-making table. The community must be involved in the planning of their own infrastructure.

Distributional

Prioritizing clean energy investments in areas that have historically been overlooked or disproportionately impacted by pollution.

Recognition

Acknowledging the unique challenges and historical injustices faced by specific populations, such as rural cooperatives or low-income urban neighborhoods, and tailoring solutions to meet those specific needs.

Restorative

Using energy policy to repair past harms, such as improving air quality in "fence-line" communities or providing job training for workers transitioning out of traditional fossil fuel industries.

Energy Poverty



"Heat or Eat" is the common phrase that encapsulates the effects of energy poverty. It describes the crisis where low-income households must choose between paying for essential utilities, such as heating and cooling, and buying food.



Our Dedication to Education

The rising generation's interest in geothermal is vital to achieving our goals; saving the earth, and leading the vital effort to establish energy equity.

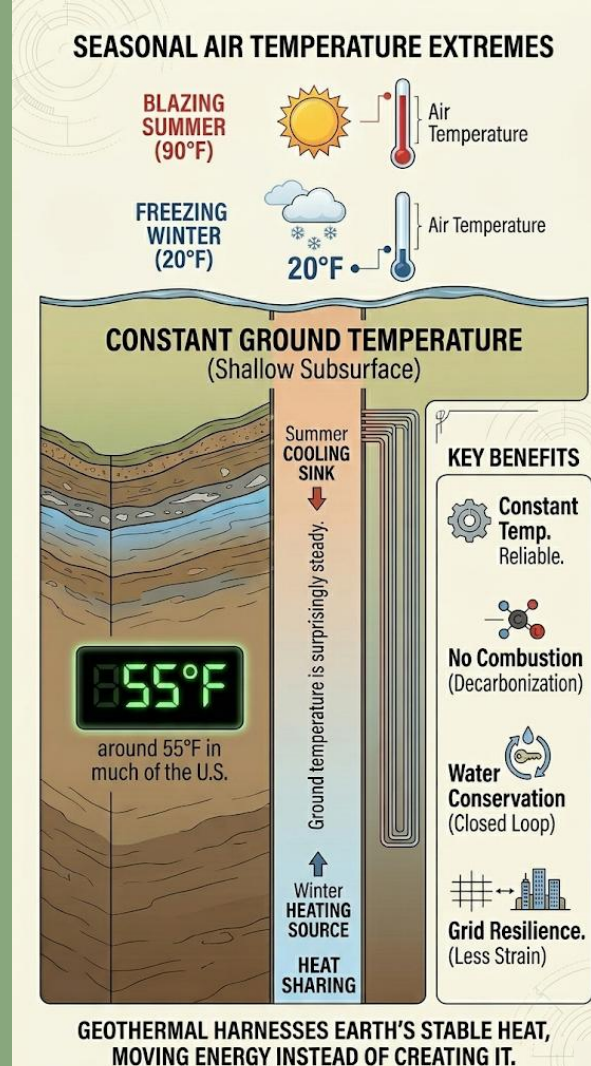
This is a vital act of stewardship, providing the foundation they need to unify the industry and scale thermal energy networks for the future.



Subsurface Temperature

The brilliant thing about our planet is that just below our feet, the ground maintains a surprisingly steady temperature all year round, unlike the air.

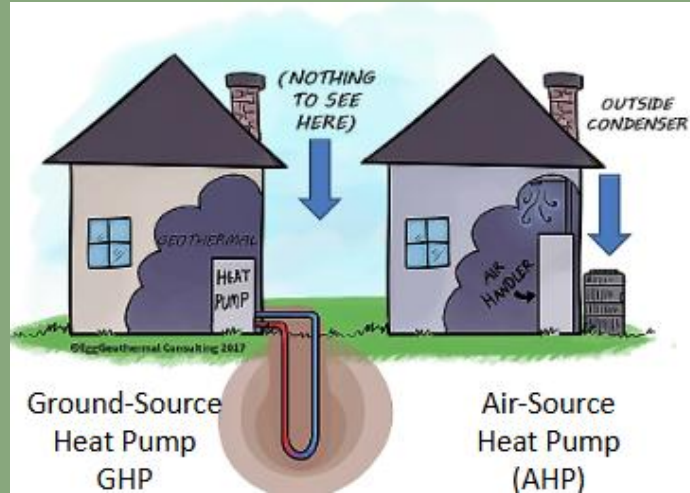
While we see blazing summers and freezing winters, the Earth's shallow subsurface (the first few hundred feet) stays at a constant, moderate temperature.



Air-Source and Ground-Source Basics

Ground-Source Heat Pump (GHP)

It uses a series of underground pipes (loops) to tap into the earth's constant temperature.



Air-Source Heat Pump (AHP)

In winter, it extracts heat from the outdoor air to warm the indoors.

In summer, it reverses the process to dump indoor heat outside.

The primary difference between these two systems is the medium they use to exchange heat. While both use electricity and the refrigeration cycle to move thermal energy, their efficiency and reliability depend on where they find that heat.

How Does a GSHP Heat & Cool?



The Cooling Cycle

- Collect: Indoor fan pulls warm air from your house across a cold coil. The liquid inside the coil "soaks up" the heat from your air, leaving the air chilled and comfortable.
- Transfer: A "reversing valve" acts like a traffic controller, directing that captured heat away from the house and toward the underground pipes.
- Concentrate: The hot gas passes its heat into the water circulating in your ground loop. Think of this as "loading the heat onto a train" to be sent away.



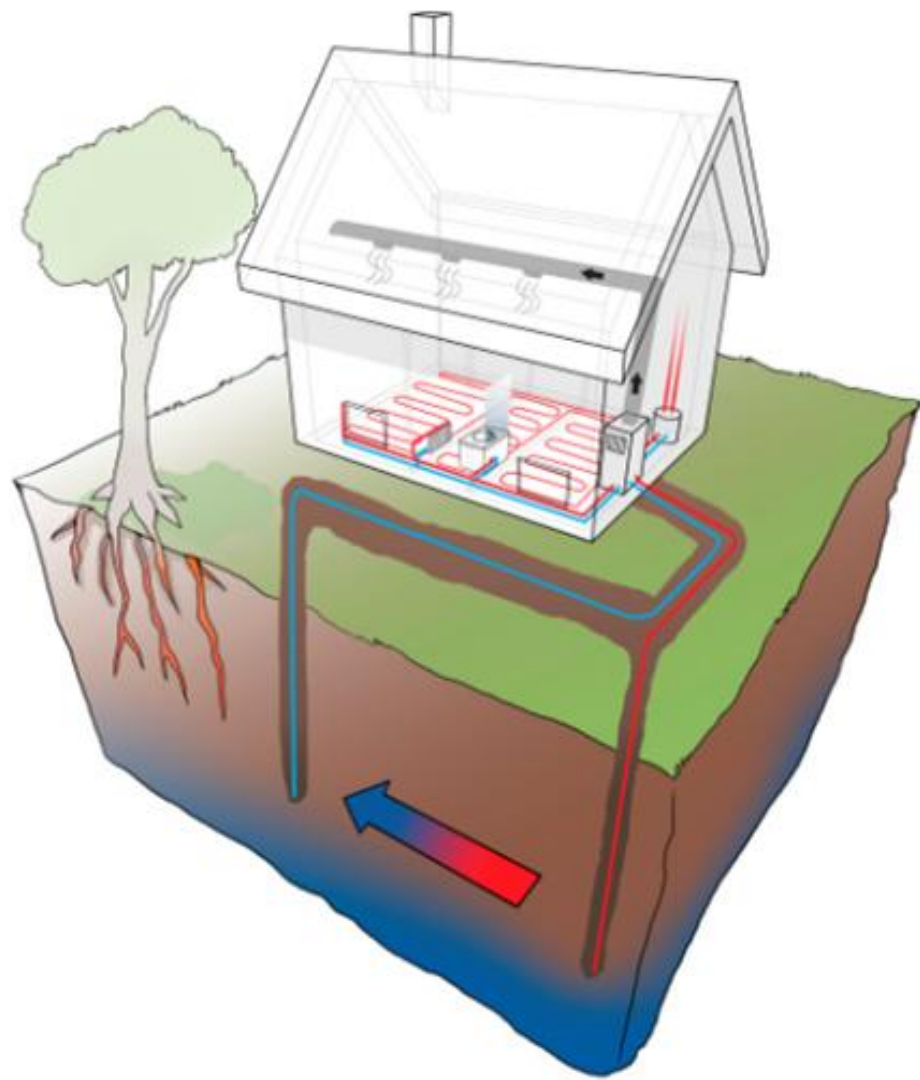
The Heating Cycle

- Collect: A water mix flows through underground pipes, soaking up the earth's steady ~50°F warmth.
- Transfer: That liquid travels inside to the heat pump, where it passes its warmth to a special "refrigerant" liquid that loves to soak up heat.
- Concentrate: An electric compressor squeezes that refrigerant, concentrated the heat until it reaches over 100°F

Typical Geothermal Applications Provide Benefits & Eliminate Problems

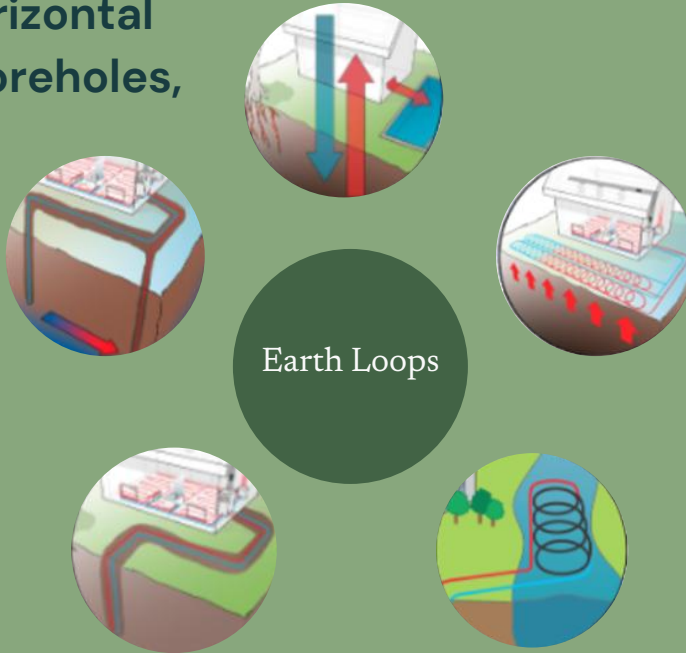
Reasoning for All-Inside Geo HVAC Unit:

- No outside noise
- No exposed associated circuits
- No exposed refrigerant lines
- No cooling towers
- No disconnects outside
- No condenser farms
- No injuries
- No vandalism



Variations in Earth Loop Systems

There is no “one size fits all” loop. Depending on the site, we might use horizontal loops, vertical boreholes, or pond loops.



We evaluate local hydrogeology to select the exchange method that is most cost-effective and provides the highest thermal performance for a specific project's requirements.

Exchanger Diversity

Geothermal is flexible. We look at what's under your feet, whether solid rock or flowing water, and we engineer the perfect bridge to tap into that energy.

Different Tools for Different Ground

- These use "conduction" (heat soaking through the pipe walls). They are great for almost anywhere.

Moving Water for Big Power (Open Loop / ATET)

- How it works: We pull water up from the ground, let it pass through a heat exchanger to grab or drop off heat, and then put it right back where it came from.

The Vertical Connection (U-Bends and Grout)

- We lower a U-shaped plastic pipe (called a U-bend) into a deep hole in the ground.



What's Happening Inside

Inside the building, the 'magic' happens in the pump room. This is where we manage the flow of thermal energy using high-efficiency pumps and plate-frame heat exchangers.

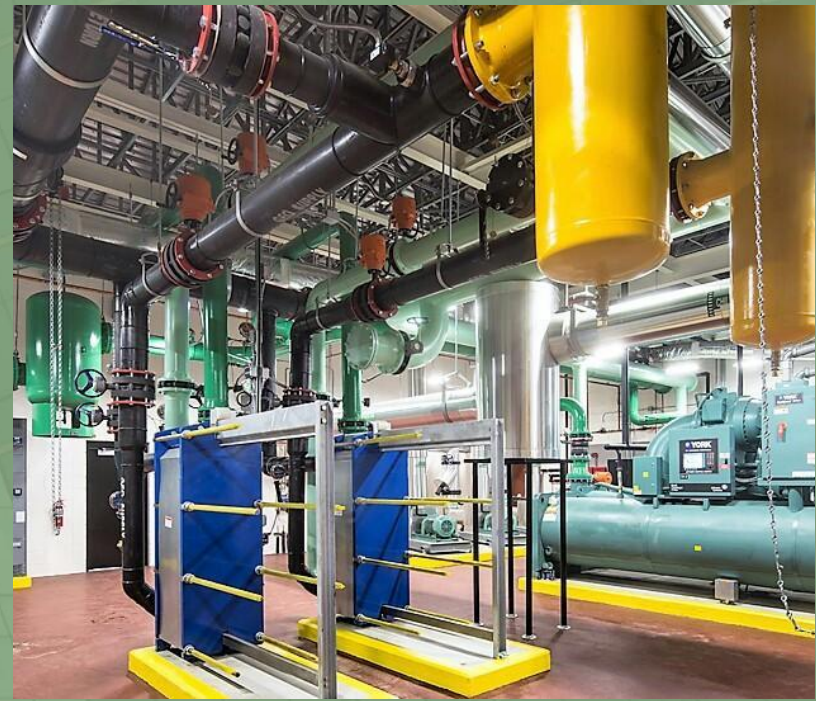


Plate-Frame Heat Exchanger (PFHE): Specialized piece of equipment designed to transfer heat between 2 fluids without them ever touching or mixing.

Types of Geothermal Heat Pumps

We no longer need one giant, messy machine. By using a "team" of small, stackable units, we can provide total comfort, from your shower to your swimming pool, using a fraction of the space.



Pool or Dedicated Hot Water GHP; (water-to-water GHP)



Vertical GHP (water-to-air GHP)



Modular & Stackable GHPs



Modular & Stackable GHPs



Pool or Dedicated Hot Water GHP; (water-to-water GHP)



Horizontal; GHP (water-to-air GHP)

Three Specialized "Team Members"

Just like a team has different players for different roles, we use specialized heat pumps for different jobs inside a building. Here are the three most common ones:



The Hot Water Specialist (Domestic Hot Water Heat Pump)

This unit has one job: making hot water for showers and sinks. It can produce 140°F water on demand, replace a traditional boiler, and run much more efficiently.

The Air Specialist (Water-to-Air Heat Pump)

If your building has vents and ductwork, this is the machine that pushes heated or cooled air throughout the rooms.

The Pool Specialist (Dedicated Pool Heat Pump)

This unit is built to handle pool water. It uses a titanium heat exchanger so the pool chemicals won't damage it.

Tampa Church Example: 70 Years of Geothermal Exchange

If you ever encounter doubt about how long this technology lasts, look at this church in Tampa, Florida.

The building itself was constructed in 1909, but the geothermal story began in 1949. That is when they installed their first ground-water sourced chiller.



See the clean, indoor environment that protects the equipment from the Florida humidity and salt air, which would have rotted a standard outdoor unit in a fraction of the time.



By choosing the ground as our heat sink, we are creating a system that can outlast the people who installed it. This church is the living definition of a "Legacy Asset."

It's Simple and Successful

Because the "exchange" infrastructure (the underground wells) was still healthy, we didn't have to start from scratch. We simply swapped out the old 1949 equipment for modern, high-efficiency Geothermal Heat Pumps (GHPs).

100% Inside: The Secret to Longevity

By keeping the units in a climate-controlled mechanical room, we protect the sensitive electronics and compressors from the brutal Florida elements—heat, humidity, and salt air.



Asset Protection: Security and Peace of Mind

In urban environments, outdoor HVAC units are constant targets for copper theft, vandalism, and accidental damage. They are also at the mercy of storm damage and hurricanes.

Disney's Grand Floridian Geothermal Exchange

[Disney's Grand Floridian Geothermal Exchange Video](#)



18

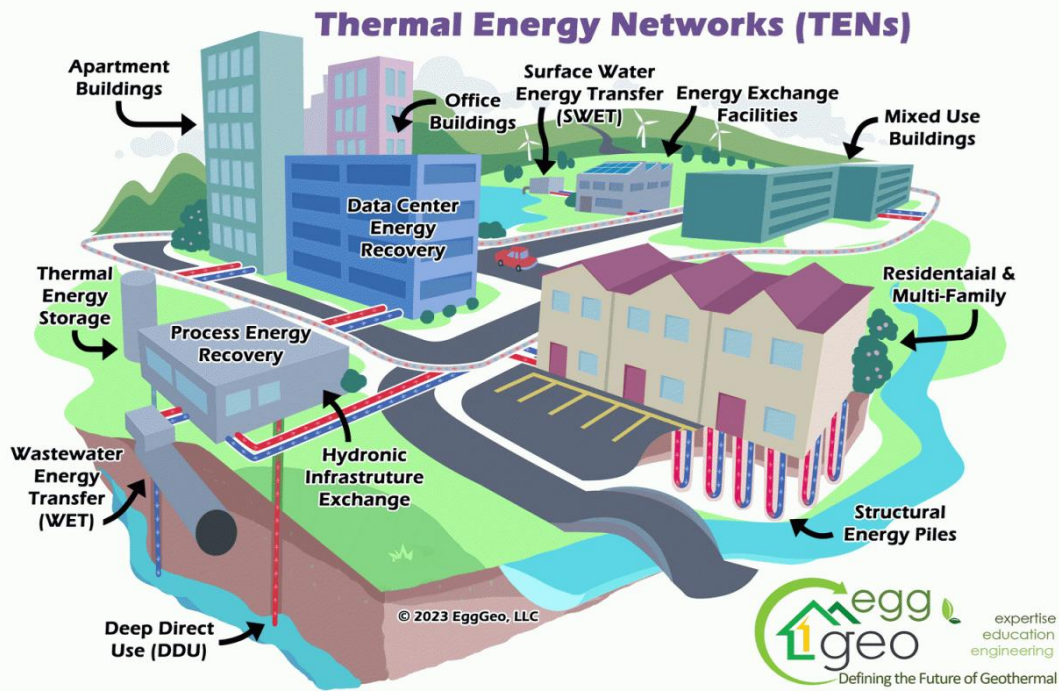
At Disney's Grand Floridian Resort, we utilize the Seven Seas Lagoon as a giant "thermal battery."

By installing large-diameter piping and specialized exchange plates directly into the lagoon, we can provide carbon-free heating and cooling to the entire resort campus.

This project reflects the visionary work of Val Usle, Disney's former Director of Sustainability Worldwide.



Thermal Energy Network (TEN) Components



Thermal Energy Networks, or TENs, are a shared infrastructure that connects diverse building types into a single ecosystem

We harvest "waste" heat from one source—like a data center that needs cooling—and deliver it to a neighbor who needs heating—like a residential home or a school.

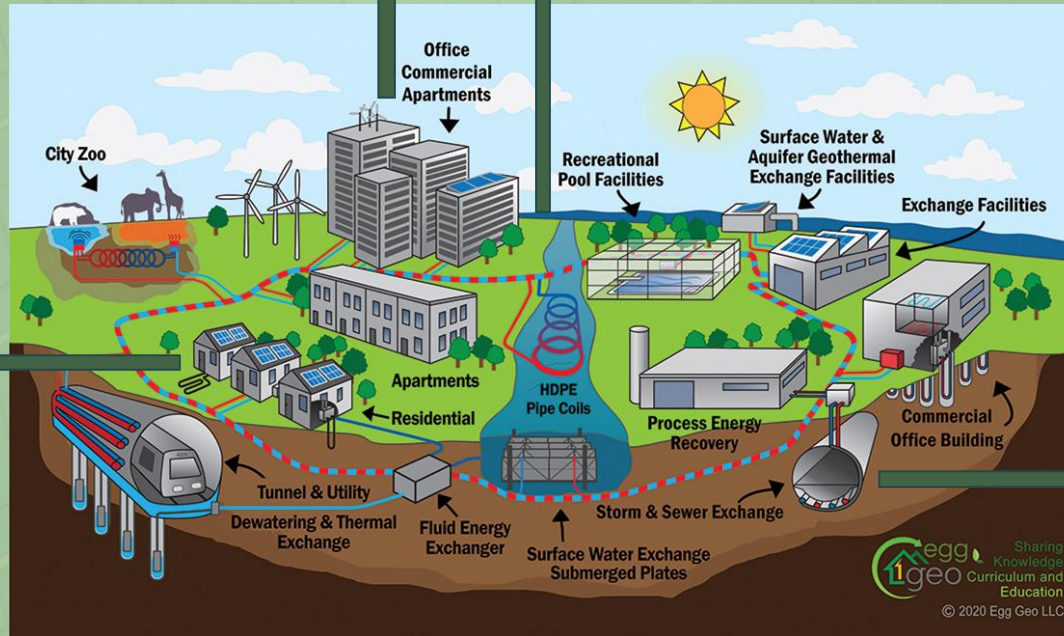
Diverse Thermal Sources

Office buildings and data centers reject heat all year long. In a TEN, that "rejected heat" becomes a valuable commodity for the rest of the network.

Surface Water: We use nearby rivers or lakes as massive thermal reservoirs.

We can link residential homes, retail centers, and recreational facilities

Wastewater Energy Transfer (WET): We extract heat directly from the sewers.



The AI Opportunity: Data Centers as "Boilers"

Artificial Intelligence (AI) is growing fast, but it requires massive data centers that stay very hot.

The Problem: Traditional data centers can use up to 10 million gallons of water every single day just to stay cool. That is a massive waste of resources.

The Solution: We stop thinking of a data center as a "computer room" and start seeing it as a "Computational Boiler." It is a constant source of free heat that runs 24/7.

Where can we apply this?



Creation of Thermal Energy Networks (TENs)

We can pull from Supply and Injection Wells, as well as Closed Loop Wells, more from Surface Water, and even tap into a Water Treatment Facility.

This is where the real "utility-scale" work happens. To move this much energy, we need high-performance, large-diameter piping infrastructure.

When you combine those diverse sources with the horizontal piping, you get a Thermal Network that can serve an entire community.



Legend

Site Layout

- Civic Building
- Office / Institutional
- Retail / Mixed Use
- Low Density Apt.
- Med Density Apt.
- High Density Apt.

Energy Sharing – From Commercial to Residential

On a cold winter day in the city, you see steam and heat billowing off the rooftops of commercial buildings. The Irony: Inside that commercial building, computers, lights, and people are creating so much internal heat that the building actually has to cool itself down, even when it's freezing outside.

Currently, that "waste" heat is just exhausted into the atmosphere—it's energy we've paid for, but we're just throwing it away.

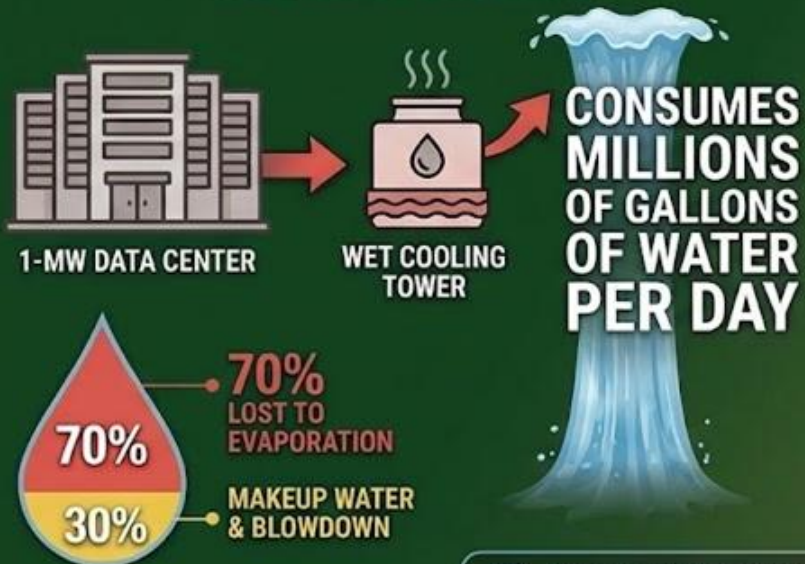


The Thermal Bridge



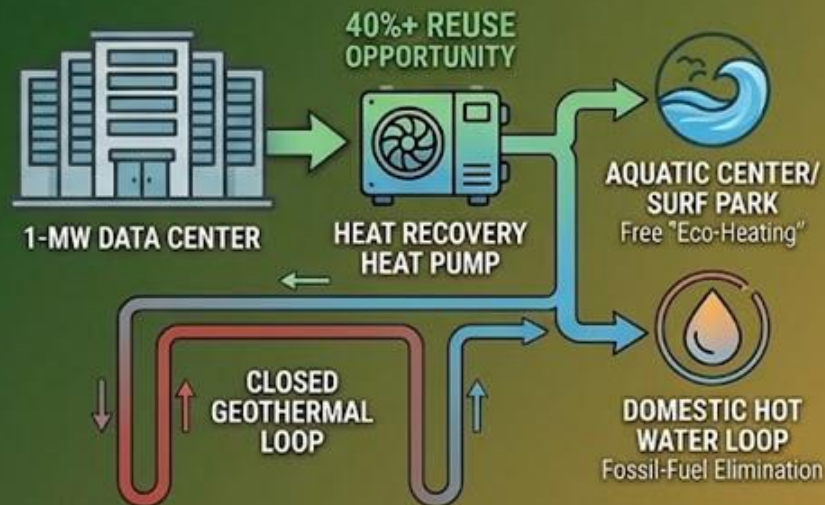
REIMAGINING DATA CENTER COOLING: WET TOWERS VS. THERMAL NETWORKS

THE WET COOLING TOWER DILEMMA: THE WATER CONSUMER



Traditional systems are increasingly unsustainable and resource-intensive

THE THERMAL ENERGY NETWORK (TEN) SOLUTION: THE WATER CONSERVER



TENs create symbiosis by matching a heat source to a thermal sink, eliminating evaporation and fossil fuels

- | | |
|---|--------------------------|
| POWER PRESERVATION: High Grid Capacity | Power Vulnerability |
| ASSET SECURITY: Protected All-Inside | Vandals & Weather Target |
| ECO-SYMBIOSIS: Sharing is Conserving | Burning is Evaporating |

GEOTHERMAL VS. AIR-SOURCE: A SIMPLE COMPARISON

1. UPFRONT CAPITAL INVESTMENT

A. AIR-SOURCE



LOW
UPFRONT COST

B. GEOTHERMAL



HIGH
UPFRONT COST

2. OPERATIONAL SAVINGS & EFFICIENCY



HIGH
MONTHLY BILLS

LESS EFFICIENCY
(NO ROI)

MONTHLY
ENERGY BILLS



MONTHLY SAVINGS? **YES**



AVOIDS HIGH
WATER TAX

RADICALLY EFFICIENT
OPERATIONAL
ENERGY DEMAND



Why Choose Geothermal?

Geothermal systems can have a “sticker shock” for some; upfront costs are greater than that of an air-source HVAC system. Geothermal has an impressive return on investment in comparison to air-source, as well as greater reliability and efficiency.

Beyond that, there are incentives financially that many people are unaware of.

THE GEOTHERMAL NETWORK: UPFRONT INVESTMENT,
RADICAL EFFICIENCY, AND DECADES OF SAVINGS

Financial Incentives

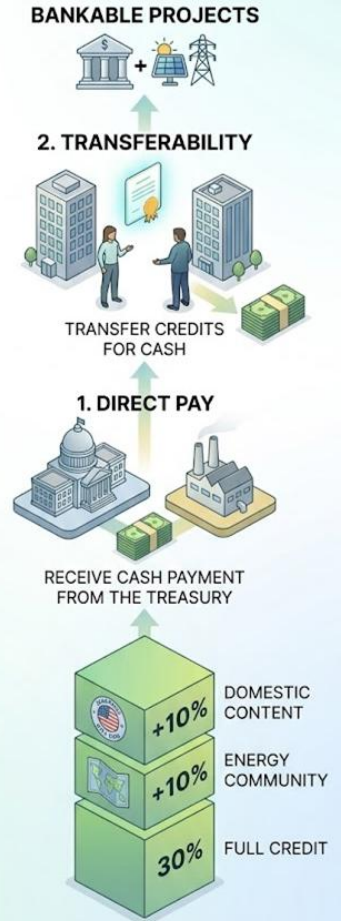
We can understand the ROI of geothermal not just through energy savings but through direct monetization of tax credits.

- Look at the 30% Full Credit cube at the base of our stacked blocks. This represents the basic geothermal investment tax credit (ITC), which provides a massive 30% credit of the eligible project cost.
- We prioritize the use of U.S.-sourced geothermal components and equipment. By utilizing domestic steel, iron, and other key materials, we are eligible for a full 10% credit bonus.
- The "Energy Community" adder applies to projects located in communities with high concentrations of coal-fired power plant employees. By placing geothermal in these exact locations, one can qualify for another 10% bonus.
- For public power entities, nonprofits, and other specialized groups, we can utilize the definitive "Least Energy Path." In these cases, the developer matches the source (credit) with the cash.

Financial Incentives (40% +)

Highlights the 30 to 40% tax credits that make these projects bankable today.

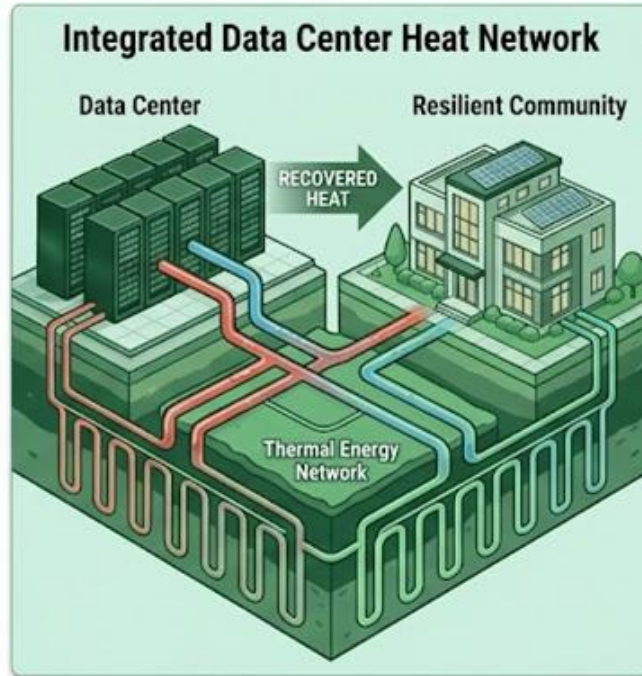
Not all credits apply to all projects.



Summary & The Path Forward

Key Takeaways:

-  1. Geothermal is a "Power Preservation" tool for energy security.
-  2. Waste heat monetization creates local community assets from thermal waste.
-  3. The subsurface provides critical grid resilience and storage.



- Eliminate replacement of outdoor mechanical equipment.



- Enhanced hurricane and storm resilience (all equipment inside).



- Increased longevity of indoor-only system components.



- Decarbonize: No combustion boilers, cooling towers, or furnaces.



- Noticeably superior comfort in both heating & cooling.



- Remarkable system efficiency at standard equipment pricing.



- Thermal Network Wells & Piping are durable, permanent infrastructure.



- Zero potable water consumption for cooling processes.

The geothermal industry is a true beacon of sustainable innovation, unlocking the Earth's own natural, constant heat to provide reliable, baseload energy.

This incredible sector doesn't just offer an inexhaustible, clean power source; it drives circular economies by turning thermal waste into valuable community assets, creating thousands of green jobs, and significantly reducing carbon footprints.

Diversity, fresh perspective, and an influx of young and excited minds will continue to push this industry into the geothermal renaissance.



Questions?

Scan the QR code to access a list of resources including contact information, LinkedIn pages, Websites, and more!

Get Involved!

Consider mentoring students and supporting the GEO@MIT work.

Use the free resources on the Egg Geo Kid's Corner page.

