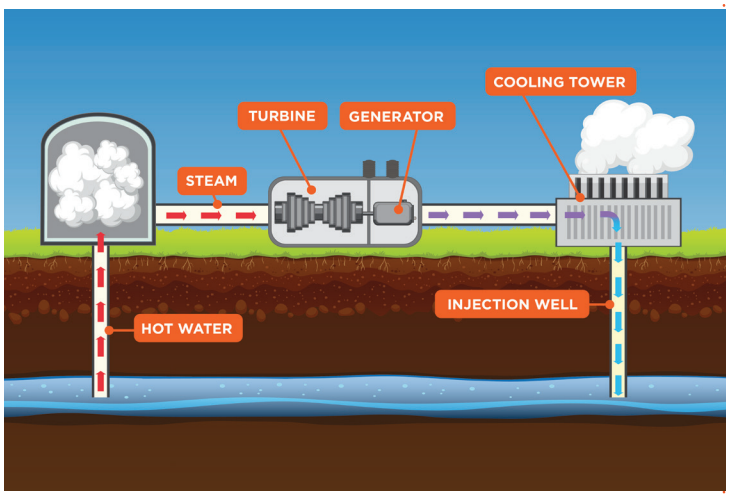
Geothermal Generation and Geothermal Heat Pumps

In the context of Austin Energy's resource planning effort, geothermal technologies fall into two main categories — geothermal generation and geothermal heat pumps. Though they share some similarities, they fall on opposite ends of the resource planning spectrum. Geothermal generation is on the power production side of the equation, while geothermal heat pumps (like you may have heard of as part of the Whisper Valley development) may affect energy efficiency on the consumer side. At a high level, here's what those different technologies look like.

Geothermal Generation

Geothermal power plants generate electricity by heating specific fluids deep in the earth's interior to create steam and then directing that steam through a turbine. To reach the temperatures required for heating those fluids, geothermal power plants generally require deep wells. These wells typically run 1 to 2 miles deep into the ground but can go even deeper when needed. Underground, the fluid has to circulate through hot rock to heat up. That permeability can be naturally occurring or manmade. Once the steam is made, a geothermal power plant functions much in the same way as a traditional power plant.



Geothermal Generation Potential in and around Austin

Subsurface ground temperatures in Austin and Travis County are some of the lowest in the state, meaning Austin is not a good near-term candidate for typical geothermal power production. Using typical geothermal technology in the Austin area, wells would have to be about 4 miles deep to reach the low end of necessary temperatures. Drilling to that depth or deeper would increase costs for a geothermal generation project.

Geothermal Generation for Austin Energy

Recent federal subsidies combined with newer technology and innovation for geothermal closed-loop systems present potential opportunities and improved economics for geothermal power plants in Texas. Austin Energy is currently working with a geothermal developer to explore and possibly pilot a small utility-scale geothermal plant using Enhanced Geothermal System Technology in an area of the state that best supports the resource. This will help Austin Energy test and better understand the feasibility and challenges of larger utility-scale geothermal opportunities in Texas.

Geothermal Generation Technologies and Methods

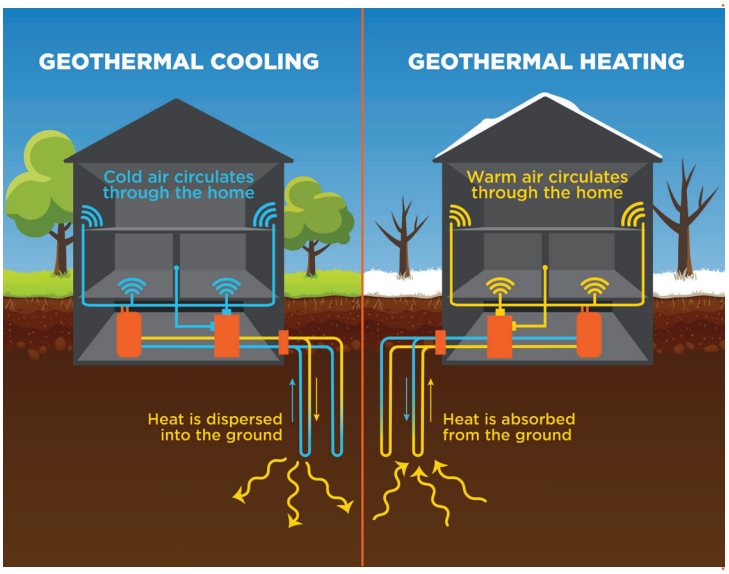
As Austin Energy is looking at geothermal generation opportunities, the utility is considering different technologies and methods that could make this power source more viable. Two of those advancements include:

- **Enhanced Geothermal System (EGS) —** In an EGS, fluid is injected deep underground under carefully controlled conditions to create new fractures and cause pre-existing fractures to re-open, creating permeability where it does not exist naturally. The Department of Energy is funding demonstration projects.
- **Binary-Cycle Power Plant —** This type of plant can use lower temperature geothermal resources. Geothermal fluids pass through a heat exchanger with a secondary, or "binary," fluid. This binary fluid has a much lower boiling point than water, and the modest heat from the geothermal fluid causes it to flash to vapor, which then drives the turbines, spins the generators, and creates electricity. Per the Energy Information Administration most geothermal power plants built today use this technology. As of 2020 there were 93 binary cycle generators in the U.S., with the majority located in Nevada because the volcanic nature of the geology is favorable for the technology.

Geothermal Heat Pumps

Geothermal heat pumps, also known as ground source heat pumps, take advantage of the ground's ability to efficiently store and discharge heat. Geothermal heat pumps use traditional heat pumps — like those used in homes today — that have been modified to transfer heat between the house and the ground as needed to heat and cool the home rather than transferring heat between the home and the air. The idea is that this can help provide more efficient heating and cooling.

Most of these heat pump systems work by circulating water — or a blended water-glycol solution — through a closed loop buried in the ground. Heat is transferred from the home to the ground in the summer to cool the home. In the winter heat is moved from the ground to the home, heating it. This can increase the efficiency of the heating and cooling systems. These heat pump systems work particularly well in areas with a balanced climate of hot and cold weather days.



Geothermal Heat Pumps in Austin

In Austin, there are many more days that require the air conditioner to run than days that need the heater, heating the ground overall. This results in a less efficient geothermal heat pump system. A solution to this problem is to add an auxiliary cooling system to remove this heat from the ground and discharge that heat into the air. While this solution can work, it results in a more costly and less efficient overall solution.

Austin Energy has conducted limited evaluations of ground source systems in Austin. Austin Energy has seen one system demonstrate the technical potential of the technology to cool houses when applied at the scale of a housing subdivision, but has not been able to verify efficiency savings or the cost of the system compared to traditional technologies at that scale. The one single-home system looked at did not work well and was more costly than a traditional HVAC system for a single family home.

Notes:

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