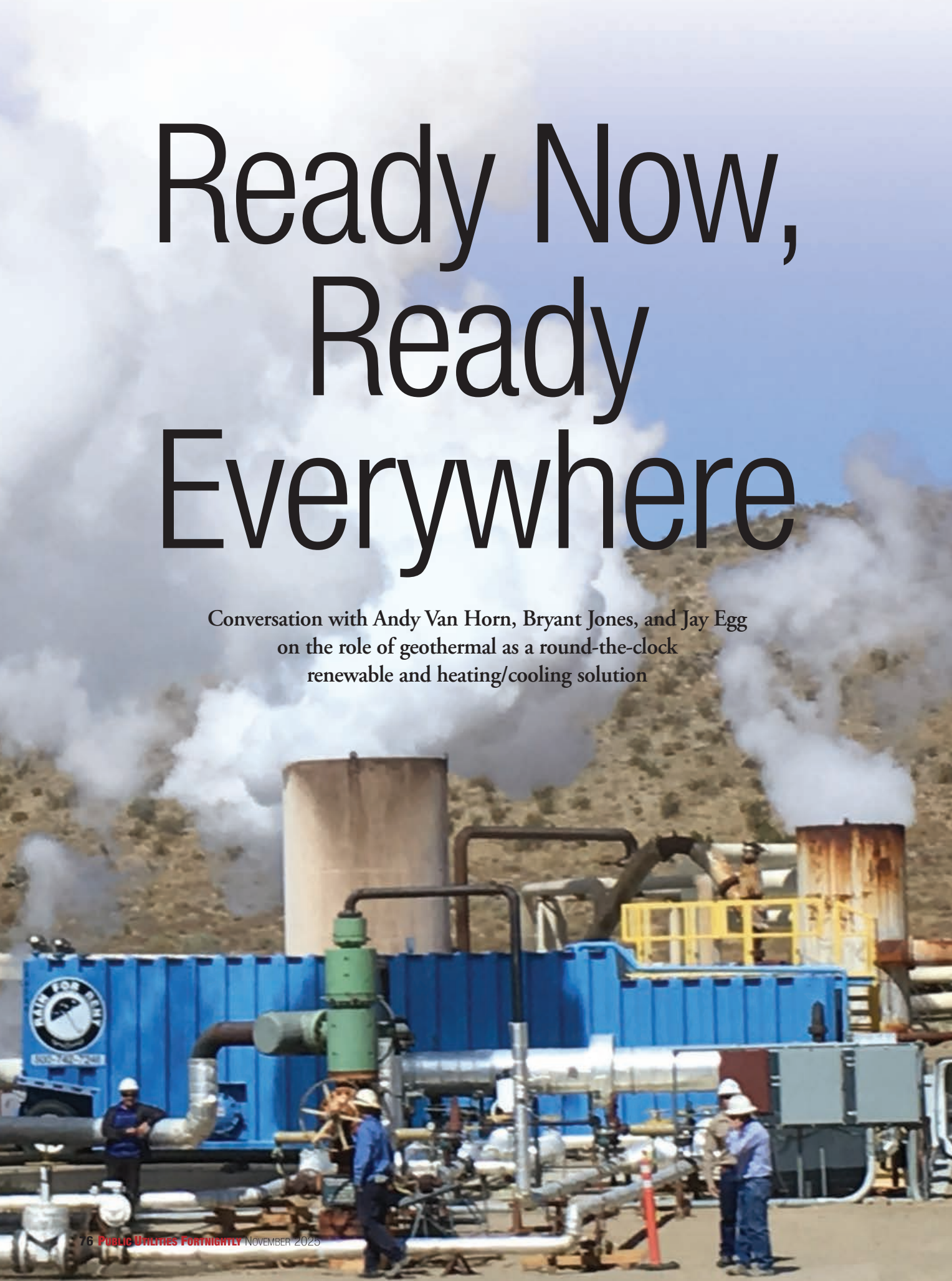
Ready Now, Ready Everywhere

Conversation with Andy Van Horn, Bryant Jones, and Jay Egg on the role of geothermal as a round-the-clock renewable and heating/cooling solution



As power demands increase, all sources must be considered, and that all-of-the-above strategy should take into account geothermal. It is a clean, renewable resource that also is a secure and reliable energy source that offers firm and flexible solutions to the changing U.S. power system.

Geothermal plants can provide steady output twenty-four hours a day and are not subject to the unpredictability and voltage swings of variable energy resources. Geothermal plants can also ramp up or down quickly, allowing them to adjust to the changing needs of the power system and act as a flexible power source in addition to baseload.

There is so much more to geothermal and Public Utilities Fortnightly went to the experts to discuss what it is all about. This conversation with Van Horn Consulting Managing Director Andy Van Horn, Egg Geo President Jay Egg, and Geothermal Rising Executive Director Bryant Jones takes a deep dive into the types and benefits of this power source.

PUF's Steve Mitnick: You all say that renewable, clean geothermal energy is ready now, for behind-the-meter and utility-scale electric power generation and heating and cooling applications. Talk about why you say, "Ready now."

Bryant Jones: Geothermal is a mature technology. It's been providing district heating in Boise, Idaho, since 1892. It has been producing commercial electricity in Tuscany, Italy, since 1913, and supplying electricity to the western U.S. power grid at The Geysers power plant in northern California since 1960.

In 2024, the U.S. had about 3.9 GW of geothermal power-generating capacity, while global geothermal power plant capacity was about 16.9 GW. A DOE "Liftoff" report indicates that over ninety gigawatts of clean firm geothermal power can be provided to the U.S. grid by 2050. With support and technology advances, perhaps over three hundred gigawatts could be built in the U.S. by 2050.

Over the decades, we have created technologies that can more efficiently and effectively harness geothermal energy, whether for heating, air conditioning, or electricity. It is very much a now and everywhere technology.

PUF: What are the new technological developments?

Andy Van Horn: In general, geothermal power generation technologies have been characterized as conventional thermal, enhanced geothermal systems (EGS), and advanced geothermal systems (AGS). AGS are primarily closed-loop geothermal (CLG) energy systems. There are multiple technologies for generating electricity as well as for heating and cooling.

There's been a public perception problem with most folks thinking that there is only one geothermal power technology: a conventional steam plant. This is primarily because geothermal power began by harnessing steam coming out of the ground to generate power in Larderello, Italy, around 1913.

In 1960, PG&E built the world's largest geothermal power plant, using wells to withdraw steam to drive turbines above ground and generate electricity. One problem with that kind of dry steam generation is that some steam evaporates rather than being reinjected into the hot rock.

Geothermal energy comes from radioactivity in the core of the Earth, and there are literally millions of years of continuous, clean, renewable energy that could meet all of mankind's needs. The question is how to extract sufficient heat.

– Andy Van Horn

Hence, the Geysers' generation capacity declined over the decades from approximately fifteen hundred megawatts to approximately eight hundred twenty-five megawatts to today. Today, innovative CLG technology being developed and tested by GreenFire Energy may be able to increase the current Geysers' generation capacity.

Geothermal energy comes from radioactivity in the core of the Earth, and there are literally millions of years of continuous, clean, renewable energy that could meet all of mankind's needs. The question is how to extract sufficient heat.

For conventional geothermal systems to succeed, the ground underneath the plant needs to be permeable, so that water heated between one hundred five degrees Celsius and two hundred degrees Celsius can flow in and continuously supply wells that bring the hot geothermal fluid to the surface, where power is generated. Some current technologies apply an Organic Rankine Cycle (ORC) and heat exchangers using different refrigerants to produce electricity by heating the refrigerant that expands and spins the turbine generator.

Recently, companies like Fervo Energy have made breakthroughs in EGS by utilizing advanced fracking techniques to increase the amount of water being heated and to maintain better flow of the geothermal fluids over decades. Because geothermal heat is everywhere, if we can access the hottest areas in deep, hot rock, we could utilize even more geothermal energy all around the globe.

The GreenFire Energy closed-loop geothermal project at the Coso, California geothermal power plant.

Overall, renewable geothermal energy is available around the clock and is reliable, clean, and sustainable. It's also resilient and secure because it's underground. As we know, energy security is increasingly important for countries trying to replace their international oil and gas purchases and for the military for enhanced site security and reduced vulnerability.

Sage, a Texas-based company, is currently developing advanced heat storage technologies. GreenFire Energy and Eavor have been developing closed-loop systems that circulate water or refrigerant through sealed pipes down into the hot reservoir. This working fluid heats up at the bottom, and then rises, driving a heat exchanger, reducing water consumption, and conserving fluid in the reservoir.

Recent advances in drilling wells and greatly increased geothermal systems research and developmental testing are reducing costs and increasing and extending facility lifetimes. These all enable geothermal energy to contribute to global electrification and decarbonization worldwide.

Jay Egg: I will share about the diversity of technologies in the cooling and heating realm. Geothermal for cooling and heating is called low temperature geothermal exchange and uses the median temperature of the ground as a heat sink for cooling in the summer and a heat source for heating in the winter.

I first discovered this while working as a nuclear power engineer in the U.S. Navy. I graduated in 1987 and began teaching at the nuclear power school in Orlando, where I also purchased my house. I was amazed at how houses were being cooled in the humid conditions against the hot outdoor temperature.

The ground was about twenty-five degrees cooler than the outside temperature. I decided to use the groundwater to cool my air conditioner and installed a water-to-refrigerant exchanger on my Trane air conditioner, which reduced energy consumption by half.

I had a good device but didn't see anybody else doing it. So, I started a company. I discovered that Oklahoma State University offers a curriculum on this topic. I flew there and met Jim Bose, the grandfather of academic geothermal heat pump solutions.

They had a program and started the International Ground Source Heat Pump Association. I learned everything from him. I was in one of the first classes to be certified on geothermal closed-loop technology.

I took that knowledge to Florida and ran my business for nineteen years. Then, a focus on renewables started with the Obama administration. We accomplished the first high-value tax incentives for geothermal heat pumps in the stimulus package of 2009. That was a boon to the industry.

I was considered a pioneer in the geothermal heat pump field. We established an online presence by 2009, when McGraw-Hill contacted us and commissioned a textbook. It was wildly successful.

Then, they had us write a graduate-level textbook, and people knew who I was. One of the first groups to call me was the New York City Commissioners. They asked, "Can we cool and heat nine hundred thousand buildings in Manhattan by 2050?"

I did presentations and started working for the New York State Energy Research and Development Authority. We developed a program that became the Utility Thermal Energy Networks and Jobs Act, signed into law by the governor in 2022.

Geothermal energy has experienced significant growth in the heating and cooling sector. Interconnected heat and power projects are transformed into heating and cooling projects due to networks, meaning a power plant cascades down to cooler temperatures while heating, and every BTU of energy can be captured. That has changed the face of the industry.

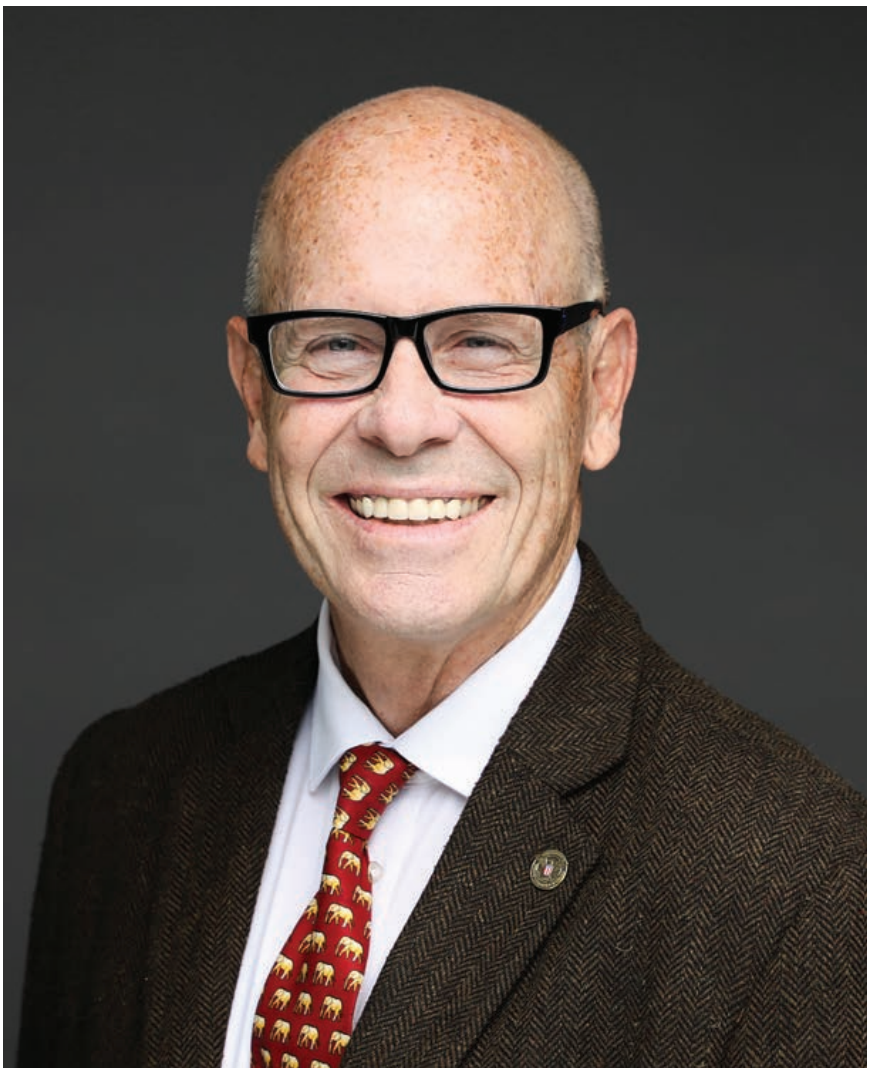
Think of geothermal classes in three buckets. There's the geothermal heating and cooling of residences with the heat pump. The second is direct-use applications of agriculture, aquaculture, hot springs, greenhouses, industrial heat applications, thermal energy networks, and geothermal district heating systems. The third is the electric power bucket.

– Bryant Jones

It used to be that the heat pump industry of drillers and contractors was separate from the academics. Now we're all working together.

PUF: How much can you scale it up?

Bryant Jones: You can't think of the geothermal industry, the power side, without thinking about the heating and cooling side. It is all one geothermal ecosystem, one industry. What we're seeing more of is companies that operate in one segment of the



Eversource removed its natural gas lines in Framingham and replaced them with geothermal lines. Now, Eversource has the same type of geothermal line moving water through, and that communicates with the geothermal heat pump the size of a furnace, and provides heating, cooling, and hot water without carbon dioxide emissions.

– Jay Egg

industry expanding into other segments. We generally think of geothermal classes in three buckets.

There's the geothermal heating and cooling of residences with the heat pump, which is the first bucket. The second bucket is direct-use applications of agriculture, aquaculture, hot springs, greenhouses, industrial heat applications, thermal energy networks, and geothermal district heating systems.

The third bucket is the electric power bucket. There are many types of technologies in that power bucket. With all the technology advances over the years, companies and organizations are operating across those three segments.

We are working to defragment the industry, ensuring the efficient adoption and transfer of technology while strengthening our unified voice. In the past, we have created barriers, and technological barriers existed between segments of the industry. That is changing as companies and organizations start producing power and selling the heat to a nearby public utility, or installing heat exchangers in buildings.

In Geothermal Rising, we promote and amplify that complete geothermal ecosystem. I was a researcher in science and technology studies at Boise State University. My area of study was energy transitions, specifically the transition from one technology to another.

Humans move from one technology to another all the time. We moved from landlines to cell phones. We transitioned from masted ships to steamships to nuclear-powered ships.

What is particularly interesting to me are the variables that ensure or limit whether or not technology scales. Primarily, there are policy, collective action, social, and organizational structure reasons behind technologies that are not adopted.

A case study of mine was about the geothermal industry. I realized it's not a technological limitation that's preventing adoption; it is all about social awareness and policy.

Geothermal does not have a technology problem. It has a policy problem, and policies have failed to consider the unique characteristics and profound benefits of geothermal energy, such as its ability to provide reliable 24/7 baseload power, support direct heating applications, sustain long operational lifespans with low emissions, and contribute to grid resilience while requiring fewer land resources compared to other renewables.

With the 2005 Energy Policy Act, signed by President Bush, the solar and wind industries gained public awareness. Geothermal

companies could also qualify for the investment tax credit (ITC) and the production tax credit (PTC). However, regulatory barriers and slow permitting continued to impede project deployment, despite the presence of some policy incentives.

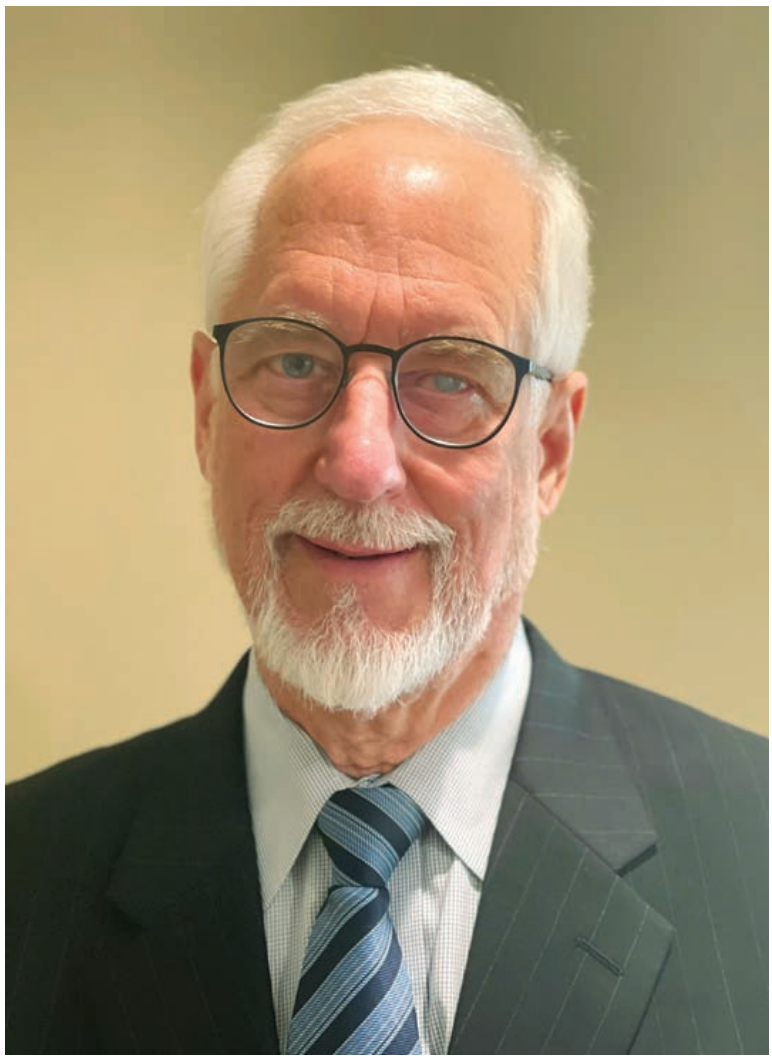
The incentives would often sunset before a geothermal company could take advantage of them. This did not create sufficient certainty for private investors to invest in geothermal energy. Consistent policy is the solution to scaling the geothermal industry. We've seen that proven out with the Inflation Reduction Act, which finally created long runways for geothermal companies to take advantage of the ITC and PTC.

That was extended under the One Big Beautiful Bill Act, also known as the OBBB Act. Geothermal has a stable, long runway now, and that is how there will be significant scaling in this industry in the U.S. Of course, Europe, Asia, Africa, and other countries have recognized the advantages of geothermal and are globally implementing geothermal energy.

PUF: Geothermal takes longer than solar and wind from conception to operation.

Bryant Jones: Yes. It takes a bit longer, but newer technologies and policies are helping now. Enhanced geothermal systems and closed-loop geothermal systems have already changed the time frame that it takes to develop a geothermal project.

We're seeing that in real time with the FORGE project that the Department of Energy funded in southern Utah. Fervo Energy and other companies have utilized the research and development that's going to speed up the deployment of EGS, and Fervo already has electrons on the grid. And Eavor Technologies will be on the grid with their closed-loop technology in Germany later this year.



One of the major costs is drilling wells to extract the heated working fluid. However, drilling has undergone major advances to reduce costs and increase productivity. The oil and gas industry has identified numerous profitable opportunities in geothermal.

– Andy Van Horn

Andy Van Horn: One of the major costs is drilling wells to extract the heated working fluid. However, drilling has undergone major advances to reduce costs and increase productivity. The oil and gas industry has identified numerous profitable opportunities in geothermal and is bringing engineers, scientists, and businesspeople into the geothermal sector.

In many parts of the world with geothermal heat reservoirs, we haven't been drilling wells deep enough. This is being addressed through ongoing research and development efforts at universities and by testing in demonstration projects.

Quaise is using millimeter waves to melt rock and granite, allowing operators to drill deeper and hotter and Quaise has successfully conducted public field tests. FERVO will now be building large EGS commercial power plants that unlock additional geothermal energy resources.

All this takes time. In the past, it took six or seven years to generate revenues from geothermal plants, but a wind farm and solar plant could be built in three years and start generating a profit. The permits to drill the wells and bring steam or hot water to the surface took years. Now, legislation and permitting processes are being revised to enable construction to begin and generate revenue within a few years.

Another key issue is price stability – geothermal wins here. It's not volatile. After upfront costs, the operating costs of geothermal plants are low, and there are ongoing jobs.

Geothermal is cost-effective and affordable, especially considering its life-cycle costs, weather independence, and its outstanding environmental benefits. That includes very low emissions of greenhouse gases, lower water consumption than fossil-fired facilities, and the capability to displace emissions from burning natural gas for heating buildings or generating electricity, which will be particularly beneficial in regions like the northeastern U.S. and Europe.

As Bryant pointed out, policy and regulatory issues are now at the forefront. Governments in the states of New Mexico, Colorado, Texas, and California are now revising regulations to bring plants online more quickly.

PUF: Jay, why is geothermal so good? What are the essentials on cost profile, sizing, dispatchability, and environmental?

Jay Egg: To draw an analogy, I wrote an article on the buildup of natural gas distribution pipelines in the U.S. during the 1950s and 1960s. Before that, the National Electrical Manufacturers Association was doing a huge rollout of all-electrified homes.

During World War II, there was difficulty getting oil from Texas to New York and the Eastern Seaboard. During the first month, over seventy tankers went down off the Atlantic coast near the shipyards where new vessels were being built and launched. So, the U.S. War Department said, "We need to get oil and gas from Texas to New York in a safer way."

They constructed two transcontinental pipelines, installing millions of miles of pipeline and infrastructure in city centers, connecting sixty-five million buildings in just two decades. That's what is being done now.

In Massachusetts, Eversource, the natural gas company, removed its natural gas lines in Framingham and replaced them with geothermal lines. Now, Eversource has the same type of geothermal line moving water through, and that communicates with the geothermal heat pump, which is the size of a furnace, and provides heating, cooling, and hot water without carbon dioxide emissions.

PUF: Bryant, can geothermal grow so that in the 2030s, it becomes a significant player in supply?

Bryant Jones: Yes. DOE estimates there's easily sixty to ninety gigawatts of energy potential to be delivered by 2050 in the U.S. alone. The International Energy Agency has released additional global estimates. The geothermal resources are endless because the Earth is always producing heat.

The attributes and benefits of geothermal include that it walks the political tightrope between the political spectrum because both sides appreciate it. It's a domestic resource that involves drilling and, therefore, has synergies with oil and gas, not just in technologies, but also in the workforce.

Geothermal is a clean energy technology. It is renewable and the only energy technology that operates in complete symbiosis with the ecosystem. If a geothermal developer depletes the resource being used, it undermines the ROI as a company. No other technology can say that.

It is also the most environmentally friendly energy technology, with the lowest life-cycle carbon footprint of all renewable technologies. And the supply chain supporting it is secure and stable. Both sides of the political spectrum see the benefits and attributes of geothermal from perspectives they value.

Andy Van Horn: Typically, geothermal plants will last thirty to forty years. Thanks to companies like Fervo and others, we are learning that those lives can be extended.

There have been 150 startups in the last two years in the geothermal space. There are numerous investment opportunities available to the private sector. Companies are seeing double-digit returns on their investment. Now is the time to invest in geothermal because there is money to be made.

– Bryant Jones

We also know that the turbines and equipment that generate power have long lives, thirty, forty years or longer. We don't know how long storage batteries will last or how to dispose of them, and solar and wind are intermittent.

In the U.S., the industrial sector produces twenty-three percent of all our carbon emissions. Globally, fifty percent of energy demand is for heat for buildings, agricultural, and industrial processes. That's true in Europe too, which no longer has the natural gas supplies it once got from Russia.

Europe is now employing more geothermal energy for district heating in towns and cities. This requires governments and people to come together, realizing that geothermal has the smallest footprint, the lowest life-cycle costs, and lowest environmental emissions, in order to help reach decarbonization goals. Geothermal plants cover one-tenth the size of a typical solar facility and are even smaller than typical wind farms.

Now, with growing demand from AI and data centers, Microsoft and Google are commissioning behind-the-meter power plants and exploring nuclear and geothermal energy options. Geothermal is the technology that can best meet the needs of these companies and provide them with the energy assurance they need.

PUF: What can a utility, state regulatory commission, or governor's office do to help move geothermal forward?

Jay Egg: We're a technology company with a team of scientists, and we do a lot of R&D in-house at our cost. What they can do, for example, is commission geothermal electric technology companies to drill a geothermal power plant where a decommissioned coal power plant once stood. The existing electric infrastructure is one of the biggest costs.

We're getting numerous opportunities to talk, but are not gaining traction with rural electrical co-ops. Fifty-six percent of impoverished Americans live in energy poverty in rural areas, paying some four hundred to nine hundred dollars a month to heat their homes with propane.

We are struggling with a profound educational and risk-aversion gap, given that the cooperatives, which are owned by the people who pay the electric bills, are not yet utilizing the full financing power of the new federal legislation within the One Big Beautiful Bill. They can completely fund these systems with no money out of their pockets, but it is difficult to be first.

It's an information problem. Rural electric co-ops could power most of the country by installing geothermal systems in their yards, much like installing a five-kilowatt solar array that never runs out and never depreciates. It never wears out.

You can go through several generations of heat pumps, but the piping infrastructure, which lasts for many decades, and the energy sources are always there. That's a big one.

Bryant Jones: The piping needed for heating and cooling for geothermal heat pumps is infrastructure that lasts for many decades. In Boise, Idaho, the wells were drilled in 1892 and are still used today. In Tuscany, Italy, and in northern California, all those wells and infrastructure are still used. That's one hundred twenty-year-old assets still in use.

Public and government officials need to better understand that geothermal is not expensive or cost prohibitive. All the fuel is purchased upfront.

There have been a hundred fifty startups in the last two years in the geothermal space. Those are developers, service providers, equipment manufacturers, and data providers. There are numerous investment opportunities available to the private sector.

Companies are seeing double-digit returns on their investment. Now is the time to invest in geothermal because there is money to be made.

Andy Van Horn: We're undergoing a global energy transition, and it takes decades for new technologies to penetrate the market. As we've shifted from coal to oil and gas, brought on nuclear plants, and built renewable power plants, geothermal is at the forefront in the next phase of global electrification and decarbonization.

Those two trends are essential to achieving mankind's goals, and geothermal is the right technology. We're seeing that in Asia, where the Philippines and Indonesia are the geothermal leaders. The United States, Europe, and East Africa are moving more to geothermal, thus accelerating the technology learning curves.

Baseload power plant costs have decreased from one hundred twenty dollars per megawatt-hour to seventy to ninety dollars per megawatt hour. For retrofits of existing wells, the costs can be in the twenty to forty dollars per megawatt range, better than the instantaneous levelized cost of a solar plant.

Commission geothermal electric technology companies to drill a geothermal power plant where a decommissioned coal power plant once stood. The existing electric infrastructure is one of the biggest costs.

– Jay Egg

Yes, the sun goes down every day, and when it's cloudy or there are forest fires or volcanic eruptions, a solar-powered system can't fully meet our needs. I would like to point out the effects of Mt. Tambora's volcanic eruption in 1815, causing a year without summer in 1816, accompanied by crop failures and migrations around the world.

In 1816, the sun was obscured for months. Despite volcanic eruptions and weather-related events, like droughts, geothermal will be available to provide grid stability, reliability, and resilience.

Bryant Jones: Which country wants to lead the geothermal decade? Will it be the United States? Germany? Turkey? China has already taken out more patents on geothermal technologies than the rest of the world combined.

As we transition to the next technology, the next innovation that humanity does all the time, the question is, who will lead the pack? If we want it to be North America and Europe, then while better policies are put in place, there's more that can be done, such as risk-mitigation funds and genuine permitting reform.

If not, then other countries will leapfrog over the West, and that is something to take seriously. PUF

Whether you're Army, Navy, Marines, Air Force, Space Force, or Coast Guard, or just appreciate how very important military veterans are in the energy and utilities workforce, you should consider attending the eleventh annual Veterans in Energy Leadership Forum on February 17-19 at the Gaylord National Harbor, near Washington, D.C.. PUF has covered this event since 2016.

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Kevin Thompson, David Terry
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& More Top Innovator Awardees

What Makes an Innovative Utility?

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Front cover: At the Fortnightly 2025 Top Innovators Conference, What's an Innovative Utility? from left, Xcel Energy Chief Planning Officer Lon Huber, Exelon Chief Strategy and Sustainability Officer Sunny Elebua, PPL Electric Utilities President Christine Martin, moderator and Energy Impact Partners Head of Innovation Evan Pittman.

A Rose by Any Other Name

Commission Names Differ, Pray Tell

By Steve Mitnick, Executive Editor

In Romeo and Juliet,
By Shakespeare
The playwright and poet,
The question came,
What's in a name?

Because it's called
the Public Service Commission
In Louisiana,
The same in Montana,
And in South Carolina.

Let's keep up this game,
It's the Corporation Commission
In Arizona,
The Utility Regulatory Commission
In Indiana,
The Regulatory Commission
In Alaska,
And the Utilities Commission
In North Carolina.

Back to that more common name,
The Public Service Commission
In Florida,
As well as in Nebraska,
And in North Dakota.

But it's the Public Utilities Commission
In Minnesota,
And in South Dakota,
And Nevada.

Oh, then there's the
Public Utilities Commission
In Colorado,
And in Idaho,
And Ohio.

Yet they call it the
Public Regulation Commission
In New Mexico.

It's the Public Utilities Commission
In California,
But Utilities becomes singular,
For the Public Utility Commission
In Pennsylvania.

Then there's the
Public Service Commission
In Georgia,
And in West Virginia.

(Cont. on page 109)

Steve Mitnick has authored five books on the economics, history, and people of the utilities industries. While in the consulting practice leadership of McKinsey & Co. and Marsh & McLennan, he advised utility leaders. He led a transmission development company and was a New York Governor's chief energy advisor. Mitnick was an expert witness appearing before utility regulatory commissions of six states, D.C., FERC, and in Canada, and taught microeconomics, macroeconomics, and statistics at Georgetown University.

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A Rose by Any Other Name

(Cont. from p. 4)

While they call it the
State Corporation Commission
In Virginia.

It's the Public Service Commission
In Mississippi,
In Missouri,
And in Kentucky,
And Wyoming.

But the Public Utilities Commission
In Hawaii,
And again, Utilities becomes singular
For the Public Utility Commission
In Tennessee.

See?

Whether it's a PSC or PUC,
As the Bard claimed,
That which we in utility regulation,
Call a rose,
By any other name,
Would smell as sweet. PUF

Innovative Ratemaking Tools

(Cont. from p. 104)

Embrace Ratemaking Outside Historical Norms – Apply narrowly scoped riders for safety, reliability, and expansion where statutes permit, with prudence review at the next general rate case.

Stabilize Capital, Stabilize Bills – Consider FRP- or RSA-style mechanisms with bandwidths and refund provisions to maintain credit health while enforcing discipline.

Pre-approve Capital Projects – When feasible, pre-approve defined project sets over five to ten years with reporting checkpoints. That lowers both risk and delivery timelines.

Publish Outcomes – Track customer affordability metrics, leak reductions, main replacements, and service expansions. Transparency builds confidence and invites improvement.

Planning for the future means acknowledging it will not look like the past. Energy requirements are changing. Required timelines are tighter at a time when projects can be delayed ten years by a broken permitting process.

Consumers across the country benefit from energy affordability and economic development. The good news is that commissions already have options to help deliver both – future test years, formula or stabilization frameworks, targeted riders, pre-approvals, and rate designs that protect those least able to pay.

States that deploy these tools with rigor and clarity will land the projects that fuel long-term prosperity. Those that do not will watch that investment go elsewhere.

To help their states, regulators should work with their utilities on tailored, forward-looking ratemaking that protects consumers and enables timely construction. Keep prudence front and center. Align payers with benefits. Ensure utilities can compete for capital and move quickly.

The economic benefits of this buildout are going somewhere. The most likely destinations are the states that innovate creatively to lower costs and shorten approval timelines. PUF

State Utility Regulation

(Cont. from p. 19)

won't have power when they need it. That's why I often say this era of growth must also be an era of preparation.

For new supply, it's all-of-the-above in an affordable and balanced manner. If we get this right, the same growth that challenges us today will drive down rates tomorrow, as we lead into an AI, information, and technology revolution.

Change can be disruptive, but it is also exciting. This is our moment to build a system that's stronger, fairer, and more resilient for decades to come. PUF

How Much Water?

(Cont. from p. 107)

A Useful Calculator

Allgood's firm, AllAI Consulting, LLC, has created the first public Data Center Water Consumption Calculator. https://www.tapsrundry.com/data-center-water-consumption-calculator (This is also the link to her entire piece we have summarized for you.).

You enter the total data center electricity, select gallons or liters and the model calculates the cooling power; water use per day; and water consumption (water not returned to the system) per day, per month and per year.

We know, it seems like cheating after walking you through all the how-to-do-it, but it is similar to when arithmetic became new math. We wanted you to understand how and why AllAI got there and it will place you, as Allgood states, "in a position to assess the validity of an operator's water resourcing plans" and enable you to ask more consequential questions early in the zoning and permitting process. PUF