



WHY THE PUBLIC SECTOR IS KEY TO BOOSTING GEOTHERMAL IN THE FIGHT AGAINST CLIMATE CHANGE

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In some ways, geothermal energy in its many forms represents the biggest possible source of clean energy to help us deal with climate change and transform the way we heat and cool ourselves and power our technological lives.

But to unlock all that energy, governments worldwide need to lead the way by supporting the primary research needed to make it possible, implementing tax policies that encourage the private sector to scale up and invest long term, streamlining permitting and approval processes, and properly valuing the 24/7 contribution of earth powered renewables.

Why invest public resources in tapping the energy beneath our feet?

To have a hope of stemming climate change, of staying under the 2° C rise that scientist have said is a critical milestone, we will need every available solution and many more that have yet to be developed.

Unfortunately, our most powerful economic driver has become the biggest threat to our survival.

Since the first commercial oil refining began in the mid-19th century, oil and gas development and technology have enabled enormous industrial and economic growth. Without it we would not have our current technological society, our power systems, or the means for rapid global travel.

But that economic growth has come at enormous environmental cost, and now we know we need to move beyond fossil fuels and reduce our carbon footprint if we want to maintain humanity and the planet.

Reducing greenhouse gas levels, getting to net-zero and eventually to 24/7 Carbon-free Energy, is a community problem, a public sector problem.

Around the world, people are becoming more and more aware of our changing climate and the impact of heatwaves, floods, and sea level rise. The public is demonstrating strong interest in seeing climate change action coordinated and accelerated by their government representatives.

This is not a matter of commercial opportunity, but a matter of global wellbeing and possibly even survival. We don't have time to wait for the private sector to figure out on its own that there is money in carbon-

free renewables.

We need massive amounts of creativity and innovation, and we need it as soon as possible. Then we need to get those new ideas into production and scaled up quickly.

Accelerating global deployment of wind and solar power has made a big dent in fossil fuel use for power generation, and these intermittent renewables are now cheaper than fossil fuels for power; electric vehicles have lower ownership costs than their internal combustion predecessors.

None of this would have been possible without public sector support to get the ball rolling. Tax incentives, loan guaranties, and funding for primary research all enabled these solutions to be created.

But to get all the way to 24/7 carbon-free power we need resources that are baseload-capable and dispatchable. That deliver energy at night, in the winter and when the wind isn't blowing. To get to 24/7 carbon free heating we need solutions that can replace gas and oil for residential and commercial furnaces and boilers. And as the Earth warms, we need more 24/7 carbon-free cooling.

The answer to all of these needs is right beneath our feet. The same place we got all that coal, oil and natural gas can help us replace all of them.

As the Baseload Capital website says "The Earth Has Power. Let's Switch it On."

Actually, the Earth has unbelievably enormous amounts of power.

By some estimates, the total thermal energy in the Earth's crust is something like 15 million ZettaJoules. That's 15,000,000,000,000,000,000,000,000 Joules. OK, it's an incomprehensible and meaningless number, so here's an easier way to put it in perspective:

It's over 20,000 times more energy than we could get from all of the fossil fuels on the planet.

For more detail, and an excellent explainer on the current state of advanced geothermal development, take a look at this great article by Eli Dourado.

So we have enormous energy resources available right under our feet but how do we unlock it?

Geothermal energy is unique in that it is both a proven approach that has already demonstrated gigawatt-scale operation, and a brand-new category with hundreds of new technology possibilities that all need research, seed funding and support to reach global scale. And of course, it delivers clean, resilient, always-on energy with the smallest footprint and lowest environmental impact.

For perspective on the evolution of geothermal, let's think about the history of the oil industry. Oil was known for thousands of years before we started drilling in the mid nineteenth century wherever it came out of the ground. In the US, Azerbaijan, Trinidad, Poland and Romania we produced oil at depths of less than 100m.

After a century of technology development, we can produce oil from wells in many other countries, from offshore platforms deep in the ocean, and at depths of 12000m. 120 times deeper than in 1860, in much more hostile conditions. And that innovation was supported all the way by the public sector. According to the IMF, global public sector explicit support for fossil fuels was estimated at almost half a trillion euros in 2020.

I believe that geothermal energy is on a track similar to the last century of oil and gas.

Geothermal energy has also been known for thousands of years, and we have tapped many of the obvious places on Earth to generate significant power from now-traditional hydrothermal systems. Even at this early stage we have proven that geothermal is capable of gigawatt production scale. We are like the oil industry in 1900.

With R&D support, public policy incentives and lots of creativity, we could harvest a much greater fraction of that near limitless supply of Earth power and do it everywhere.

Let's repeat the oil and gas innovation curve but do it faster and cleaner. With earth power.

We need a major push to get access to the energy beneath our feet and we need governments around the world to get the ball rolling.

How can governments and other public entities help?

First, support primary research and development

through public institutions and grants. The two biggest technical challenges for scaling up geothermal energy of all types are dealing with high temperatures and reducing the cost of drilling. If we can solve these two problems with new technology, we will massively expand the number of places that can adopt geothermal and the energy that can be generated.

Second, implement consistent, supportive tax policy and streamline the permitting process. Geothermal power plants are capital intensive to build but very cost-effective to operate, so they need predictable and consistent public sector support. Consistent tax policy allows private investors the assurance they need to invest for the long-haul in clean power.

Because geothermal power has been an unfamiliar presence in many places, it is often unnecessarily complex and time consuming to deal with regulatory processes that don't understand it. We must absolutely make sure that geothermal development does not have a negative impact on the very planet we are trying to protect, but we must get more efficient at working through the government processes needed to protect both the public and the environment. The latest technology enables geothermal power plants to co-exist with natural resources; 100% reinjection for example allows for the ongoing support of natural thermal features.

Third, recognize the value of 24/7 energy. Most discussions of energy prices to date have not considered 24/7 operation or the value of high operating capacity. The most commonly used metric (LCOE or Levelized cost of Electricity) simply divides the total lifetime cost of a system by the MWhrs of energy generated to get a standardized cost. But it says nothing about "when." So, a plant that operates around the clock at near 100% capacity gets no additional credit over a resource that operated intermittently.

As we continue the shift from fossil fuel generation to 24/7 carbon-free energy, this ability to provide energy any time and every time is going to become critical. We cannot get there with only intermittent resources. Today, the only energy sources that can generate clean power around the clock are geothermal and nuclear.

Fourth, recognize the value of avoided infrastructure

cost. In addition to the need for more generating capacity, electrifying everything will have massive impacts on the scale of necessary grid investment and strain our transmission systems. Applying geothermal technology closer to the consumer, in the form of district heating and cooling or ground source heat pumps, can have an enormous positive impact on transmission needs.

Lastly, we need an all-of-the-above strategy at two distinct levels. Geothermal must be seen as an important renewable energy source alongside wind and solar, but this is about more than electric power. We also need to see every form of Earth energy as part of the climate crisis solution. When it comes to supporting geothermal projects, we will need it all - traditional hydrothermal, EGS, AGS/closed-loop, Super Hot Rock and ground source heat pumps, as well as district heating and cooling.

With the right public sector support, plus private sector resources and technology, we can collectively deliver on the UN's Sustainable Development Goal #7: ensure access to affordable, reliable, sustainable and modern energy for all.

I don't think I could improve on Eli Dourado's closing words from the article referenced above:

"If we play our cards right, human civilization could soon have access to a virtually inexhaustible supply of cheap and clean energy. Shouldn't we pull out all the stops to get there?"

This might not be the Geothermal decade - it could well be the Geothermal century.

