

## Lecture #1

### Geothermal Essentials – Introduction to Geothermal

December 8, 2021

#### Q&A

**Presenters: Dr. Catherine Hickson P.Geo (CJH) and Dr. Steve Grasby (SG).**

Q: As part of the energy paradigm shift do you believe geothermal can play an important role to accelerate decarbonization and do you think "big" oil & gas companies will greatly support the transition?

A: **CJH** Yes, but it will take significant capital investment. We have had limited traction from oil and gas companies - they are interested, but geothermal doesn't meet their internal financial hurdles. There is interest in carbon credits however that come from geothermal developments in existing petroleum fields.

Q: Look at the recent IEA report on Renewable Energy 2021: <https://www.iea.org/reports/renewables-2021>. In this report there is very little about geothermal energy. For example, it lists none of the geothermal projects in Germany and the Netherlands. Why is there so little attention to deep geothermal applications? It is all solar and wind that is taken into consideration. CCS certainly gets lots of attention in this IEA report.

A: We absolutely need to get governments at all levels more engaged, and for them understand that geothermal is scalable, but only with capital investments.

Q: Could you please post a link to the plot of geothermal investment and oil price? I'd like to take a closer look at it. Thanks!

A: **CJH** Will do - we will be posting some papers that have the diagram and more explanation behind it.

Q: Okay, is (are) there any link(s) you can provide that describes the cost/budget/economic details of various geothermal initiatives?

A: **CJH** Yes, but it is important to realize that because we are dealing with the subsurface, the costs are different in different places. The temperatures and flow rates vary with location. Also there is a broad spectrum of "geothermal" projects - everything from deep conventional brine extraction to geoexchange which uses the shallow subsurface as a battery.

Q: Are there any areas in Canada where running the systems as a non-closed loop would improve the cost structure (i.e. without having the re-injection wells)? I currently work in Taupo, New Zealand where there are numerous geothermal power stations built on a volcanic system - many of the older systems were not closed loop to reduce the cost. Drawback is the large amount of subsidence generated around the fields

A: **CJH** Early geothermal development often did not have injection - unfortunately this led to damage of the subsurface reservoirs, subsidence, and other issues as you note. Places like Geysers in California solved this problem by supplementing injection by using municipal wastewater. Reservoir management is now of prime consideration, and I know of no developments that don't fully reinject, because of the historic problems. There are several companies that are looking at "closed loop" systems, which have various variations - downhole heat exchangers for example. There will be more details on these systems in a later lectures.

Q: Are larger-scale geothermal opportunities feasible without government incentives / subsidies?

A: **CJH** Yes, but it is getting over the initial hurdles in a country like Canada with significant natural gas resources used for heating and hydro power which is considered renewable energy. What changes the metric for Canadian development is carbon credits. Several of our provinces have a carbon intensive grid, so get more carbon credit for putting electricity on the grid. The biggest hurdle is the large capex required for the first wells - these wells have the highest risk. It is because of this we have been suggesting that drilled wells, if not commercially viable for geothermal, could be used for oil field brine disposal, or carbon sequestration. We at Alberta No. 1 are especially excited about the carbon sequestration potential.

Q: Where the power authority is no longer entertaining energy purchase agreements, can you please speak to a few prime examples for direct use to lower overall costs of living for residents and promote food security in northern communities?

A: **SG** Nunavut is working on evaluating its geothermal potential as is the Yukon and NWT.. The best existing example is Chena Alaska where they are operating a high latitude geothermal heated greenhouse.

Q: This question, I believe, is more so relevant to Ontario. How do you think geothermal energy is able to hold up against nuclear energy? Especially given that 1) the Ontario mix I believe it is more than 40%, and 2) the delta T is not as favorable in Ontario.

A: **SG** They are not too comparable, nuclear has huge power generation capacity but it also comes with large risks that have seen several countries decide to step back from nuclear power. Countries that still have nuclear generation face the ongoing problem of waste disposal that has yet to be solved, so the true costs of nuclear remain unknown. We will also pass your question onto another colleague but you can check out his blog postings <https://www.geothermalcanada.org/maurices-blog> on our energy future..

Q: To your perspective of view, why geothermal energy hasn't picked up like solar or wind although it has big green and renewable promises?

A: **CJH** Because it is technically complex; has a high capex and doesn't provide the same payback in the same timeframe as hydrocarbons. Geothermal investment is for the patient investor who believes in the planet before quick fast high returns.

Q: Great presentation Catherine and Steve, Thanks very much. Do you know of any institution and universities that offer courses in Geothermal. Appreciate if you could share the information.

A: Yes, Geothermal Canada has a Student's section <https://www.geothermalcanada.org/students-page> . One of the update papers on Geothermal in Canada has a more complete listing of programs several, we will post some of the options.

Q: Do you see more growth potential in electricity generation or heat delivery?

A: **CJH** It depends on the jurisdiction. In countries with high density populations including existing hydronic systems, it is a much easier to segue to geothermal. This is what is happening in Europe where there is a long history of district heating and already in-place infrastructure. Many places, like Paris, have been using geothermal district heating for decades. <https://www.thinkgeoenergy.com/geothermal-greater-paris-area-making-better-and-better-use-of-enormous-potential/> Another driver is security of supply of Natural gas supplies. In a jurisdiction like Canada, where we have a very sparse population and already existing gas infrastructure the cost to add hot water district heating is very high. We need to target new subdivisions, industrial parks, and community buildings. What is important to remember about geothermal – unlike other renewables, if we produce power, heat is still available for direct use. Also, thermal projects are less costly and technically easier to execute. Most of us are still thinking about power and we need to pivot to looking at how to harness the valuable heat that is currently being wasted while pumping hydrocarbons.

Q: Hi all, thank you Steve and Cathie for the great presentations and your thoughts and insights in Geothermal. I'm new to Geothermal after 40+ yrs as a Production Geologist in O&G. I've been involved in global LNG projects through my career which has some similarities with Geothermal. The reason is that it takes Government Involvement, Govt Tax Incentives, and long-term signed contracts for the gas.. I reckon the same will be needed in Geothermal.. Of course now days there's \$\$\$ for subsidies.. but the Geothermal Industry will need a long-term view of how this will work.. thanks again.

A: You are absolutely correct - and that is why we are trying to work closely with governments to provide those kind of incentives. Here in Canada we are beginning to get some traction, but it is hard work.