

Background

To prevent the catastrophic effects of climate change occurring around the world, the global economy must transition to net zero greenhouse gas emissions by 2050. Geothermal energy is a renewable energy source that produces clean and reliable base load electricity. Canada has failed to implement the policies necessary to develop a geothermal industry. The Canadian Government can learn from the policies implemented in the United States that has similar geology and governmental structures. Canada can also partner with companies like Ormat Technologies which has an extensive history of successful geothermal power plants around the world. Through the combination of an extensive literature review and case study analysis, this paper demonstrates that it is feasible to develop Canada's geothermal industry with appropriate policy support and implementation. If these policies are properly applied to each development phase, geothermal energy can become a critical part in Canada's renewable energy portfolio and help the global transition to net zero.

Research Questions

- (1) How can transformative policy effect geothermal energy development within Canada?
- (2) What can the Canadian government learn from the success and failure of geothermal projects in the United States?

Methodology

- This research paper utilizes qualitative, mainly secondary data to examine policy gaps and improvements the Canadian and the United States government has made over the course of their development in geothermal policy
- Developed a database of twenty US geothermal projects and looked at factors correlated to the success and failure of any given project
- Two case studies in the United States were evaluated one that has succeeded and one that has failed
- Assessed a future Canadian geothermal project to see if the same factors are present
- Conducted a thorough policy analysis in which these energy projects are being introduced and approved – examine the economic, voluntary, and regulatory tools the state or federal government uses

Key Findings and Case Studies

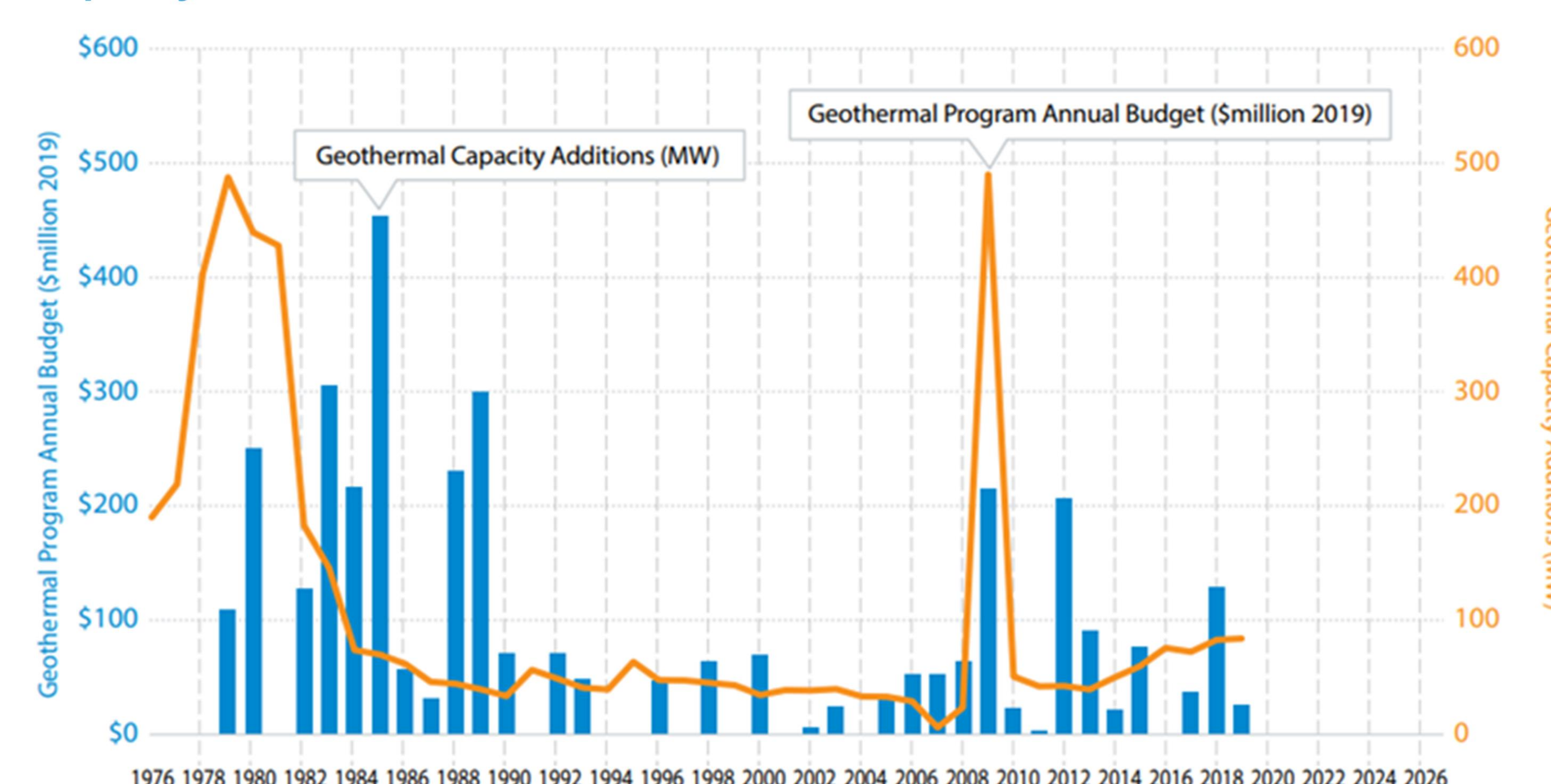
- Eighteen of the geothermal projects were successfully commissioned and two of these projects failed to be developed
- There were several different companies utilized to build these geothermal power plants across the United States. Ormat Technologies (6), U.S. Geothermal (3), and Terra Gen LLC (2) were the most common corporations tasked to explore and develop geothermal resources
- The power output ranged from 0.4 MW, to 272.2 MW on average the geothermal power plants generated 45.23 MW of output power
- The twenty geothermal projects received on average \$34.36 million dollars in federal incentives

Project Name	Location
Don A. Campbell	Nevada, USA
The Geysers (Expansion)	California, USA
Eavor Loop Pilot Project	Rocky Mountain House, Canada

Discussion

- The United States has experienced three periods of robust federal support for geothermal development and exploration
- The first period occurred in the late 1970s into the early 1980s¹
- The second wave of financial support coincided with the American Recovery and Reinvestment Act of 2009 and the third wave can be linked to the Energy Act of 2020²
- In the first and second wave the amount of geothermal capacity increased significantly both during and shortly after these periods, compared to other years
- Geothermal energy projects in this study are located on the West Coast, in California and Nevada this is due to the high heat potential from the Cascade Arc³
- In addition, these geothermal projects are developed in clusters. For example, in Southern California there are nine geothermal power plants developed within a five-kilometer radius around Salton Sea⁴

DOE's Annual Geothermal Budget Overlaid with the Annual Geothermal Capacity Added in the United States



Recommendations

Project Phase	Policy Recommendation
Resource Identification	Government provides funding for both geothermal and mineral companies to upload their data onto a central data base which is accessible to the public
Resource Evaluation	The government provides partial cost reimbursement for unsuccessful drilling in the exploration phase. Reimbursement is paid if the borehole does not produce heat capacity
Test Well Drilling	Loan guarantees by a government agency, bilateral development bank or public entity to provide a guarantee of full or partial debt repayment to a lender if the borrower defaults
Production Well Drilling	Entering a power purchase agreement with a reputable credit counterpart to ensure a steady revenue stream for the next ten years of the operation
Plant Construction and Operation	Competitive Tenders to construct and operate a geothermal plant of a specific size, at a fixed electricity price has the potential to drive down overall costs of the geothermal project

Conclusion

- As energy demand grows within Canada and new climate change commitments are declared by the Federal Government, Canada must find a way to meet both contentious issues
- Canada's untapped geothermal resources is a cost-effective way to increase Canada's annual energy capacity and reduce greenhouse gas emissions
- Canadian Federal government needs to increase spending on geothermal incentives and introduce new policies that allow geothermal energy to access funding other renewable energy technologies currently have

References

- ¹ Robins et al., 2021
- ² Linga, 2020
- ³ United States Geological Survey, 2022
- ⁴ Witherbee, 2012