Decarbonizing remote communities in Canada: A Case Study of Tu Deh-Kah geothermal project, Fort Nelson, BC

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Summary

The Tu Deh-Kah Geothermal Project in Fort Nelson, BC, owned by the Fort Nelson First Nation, aims to transform depleted gas wells in the Clarke Lake gas field into geothermal wells for electricity generation. Potential exists for additional “value added projects” such as harnessing residual heat for greenhouses and buildings, and coupling with hydrogen production (Bercovici, 2022). The project is in phase 4 of initial planning stages, having completed a successful 30-day pump test, and intends to be operational by 2026 with a total of 10 wells and 7-10 MW of power (Barkley Project Group, n.d.). As a 100% First Nation owned and operated project, the Tu Deh-Kah geothermal project is poised to offer many learning opportunities for decarbonizing remote communities in Canada and meeting net-zero goals (Tu-Deh-Kah, 2023).

This case study will assess technical efficiency enhancements to consider such as alternate secondary fluids and hydrogen coupling. Additionally, we will assess the socio-economic and policy implications of geothermal development in remote communities including benefits, drawbacks, and recommendations for improvements based on learnings from Tu Deh-Kah.

Introduction

Geothermal energy emerges as a pivotal and non-intermittent solution for Canada, particularly in its remote and northern regions. Canada's reliance on geothermal power is justified by its low carbon impact, resource-rich potential, and stability (Dincer I. and Ishaq H., 2022). In isolated Indigenous settlements with limited access to regional electricity infrastructure, geothermal energy addresses the prevalent use of diesel for electricity and heating, offering a cleaner and more sustainable alternative. The implementation of binary geothermal technology, capable of generating electricity efficiently even at lower temperatures, proves to be a promising solution for harnessing the substantial recoverable thermal energy within the Clarke Lake Field aquifer. This energy is around 10.1×10^{14} kJ, which is equivalent to around 165 million barrels of oil, presents a substantial and renewable resource that could significantly benefit the Fort Nelson region, aligning with Canada's clean energy goals and mitigating issues of intermittency in these northern areas (Warren Walsh, 2013).

The Tu Deh-Kah (TDK) Geothermal project, led by the Fort Nelson First Nation (FNFN) and its economic development arm, Deh Tai Corporation, is strategically located in the depleted Clarke Lake natural gas field in close proximity to FNFN. The project aims to repurpose exhausted gas wells into geothermal wells for electricity generation and greenhouse heating. Its significance lies in its role in the energy transition for diesel-dependent communities in BC, Canada, serving as a symbol of progress and showcasing the versatility of geothermal systems. Beyond traditional uses like electricity and heating, the TDK project addresses food security, acting as a catalyst for clean energy adoption and contributing to resilience and sustainability in remote communities, marking a substantial step forward in the region's sustainable development (Miranda, et al. 2022).

Method

The TDK project aims for a substantial environmental impact by strategically minimizing effects through the drilling of ten wells, including bi-directional ones, to generate 7–11 megawatts of power. The innovative process, illustrated in Figure 1, involves extracting heated brine, converting it to isobutane, and using vaporized steam to drive a turbine connected to a generator. Following comprehensive engineering and financing in 2022, production well field development and plant construction are slated for 2023–2024, with commercial operation expected by early 2025. Given Fort Nelson's lack of connection to the provincial electrical grid, the geothermal power produced is intended for sale to BC Hydro, contributing to regional energy supply. The project explores the binary geothermal technique using isobutane and evaluates alternative approaches, including coupling hydrogen production, investigating alternative fluids, and assessing their efficiency. The initiative outlines a comprehensive strategy for energy diversification, incorporating geothermal energy for hydrogen production to broaden revenue streams, align with environmental goals, and contribute to long-term sustainability and economic benefits. The economic impact assessment focuses on evaluating the feasibility of coupling hydrogen production with geothermal energy, analyzing cost savings, revenue gains, and overall project profitability, emphasizing its potential as a promising avenue for sustainable energy with positive economic, environmental, and energy diversification impacts (Ghazvini et al. 2019).

Ensuring geothermal power plant safety is vital for viability and community trust. Prioritizing safety, complying with regulations, and implementing mitigation strategies, like real-time monitoring, are crucial. Optimizing working fluids, exploring alternatives like Hexane, Pentane, or R113, are important considerations for efficient energy extraction. The TDK geothermal project promises broad socio-economic impact, diversifying energy sources, enhancing resilience, and creating jobs. Aligning with Indigenous values, sovereignty, and economic goals, it serves as a model for sustainable community development and offers valuable lessons for other similar initiatives. There are also opportunities to better understand the policy and regulatory frameworks' role in hindering or facilitating geothermal projects in remote Canada. The study aims to understand how federal and provincial policy can be aligned to provide the maximum benefits to society, the economy, and the environment.

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