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Social Acceptance of Geothermal Systems in Western Canada: Perspectives from Alberta and British Columbia

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INTRODUCTION

Canada ranks among the world's highest per-capita energy consumers, averaging about 270 kWh per person per day, one of the highest levels globally (Tian et al., 2023). As a signatory to the Paris Agreement, Canada has committed to reducing greenhouse-gas (GHG) emissions and achieving net-zero by 2050. Yet progress remains uneven across provinces because of differing resource endowments, policy frameworks, and institutional capacities (Thompson, 2022). Alberta, the country's largest emitter, continues to rely mainly on fossil fuels even as wind and solar capacity expand, whereas British Columbia benefits from abundant hydropower and advances decarbonization through widespread adoption of heat pumps and clean-transport initiatives (Government of Alberta, 2024; Government of British Columbia, 2024). These contrasts underscore the decentralized and context-specific nature of Canada's energy transition.

In this landscape, geothermal energy is a technically feasible but underutilized resource. Covering shallow geoexchange, traditional hydrothermal, and innovative ultra-deep geothermal systems (UDGS), it can provide continuous, low-emission baseload power and direct heat, supporting decarbonization in buildings and industry while enhancing Canada's renewable-energy portfolio (Graham et al., 2022; Hickson & Smejkal, 2024). However, despite these advantages, geothermal remains a niche technology (Leitch et al., 2019; Corbett et al., 2023), and empirical evidence on public acceptance across provinces remains limited. Technical feasibility alone will not advance deployment; smart engineering must be matched with supportive policy, adequate finance, and, critically, social acceptance.

Social acceptance of renewable technologies refers to public approval expressed through supportive attitudes and behaviors toward new or innovative options (Wüstenhagen et al., 2007; Upham et al., 2015). It reflects a broader societal consensus shaped by cognitive and emotional responses that encompass evaluative judgments and behavioral intentions (Huijts et al., 2012; Khorsand et al., 2015). International research shows that geothermal energy often receives lower public support than solar or wind, largely due to lower familiarity and perceptions of higher environmental or technical risks (Dowd et al., 2011). To examine these dynamics, this study applies an integrated behavioural framework (Huijts et al., 2012) combining the Theory of Planned Behavior (Ajzen, 1991) and Goal-Framing Theory (Lindenberg & Steg, 2007). Six key predictors frequently identified in the literature—familiarity, subjective norms, perceived fairness, perceived benefits, environmental impact, and perceived risk—are examined alongside contextual factors such as trust, demographics, and ideological orientation.

Acceptance of renewables also depends on broader energy-system attributes that citizens expect any energy source to fulfil: affordability, reliability, low climate impact, accessibility, human and ecosystem safety, job creation, and minimal landscape disruption (Boyd et al., 2019; Aklin, 2021; van Rijnsoever & Farla, 2014). These attributes form the baseline for evaluating all technologies, including geothermal.

This study examines social acceptance of geothermal systems in Alberta and British Columbia by comparing valued energy attributes, baseline familiarity with geothermal technologies, levels of acceptance, and their key predictors. It identifies provincial similarities and differences to reveal social drivers shaping Canada's clean-energy transition.

1. MATERIALS AND METHODS

A cross-sectional online survey was conducted to assess public perceptions and acceptance of three geothermal systems, geoexchange, hydrothermal, and UDGS, among adults (18+) in Alberta and British Columbia. The design enabled analysis of diverse attitudes, beliefs, and demographic characteristics across large populations.

Two province-specific questionnaires were programmed in SurveyMonkey and distributed by Leger Opinion (LEO), a professional panel provider that uses random-digit dialing and controlled online invitations to ensure demographic balance. Participants received modest, points-based incentives through LEO's reward system. Data were collected from May 12 to June 1, 2025, yielding N = 2,603 valid responses (Alberta = 1,301; British Columbia = 1,302). Gender and age quotas matched census distributions. Ethical approval was granted by the Royal Roads University Research Ethics Board, and informed consent was obtained electronically.

The questionnaire comprised eight sections, progressing from general to specific topics. Brief, neutral descriptions of each geothermal type ensured consistent understanding. A pilot test with 63 participants confirmed clarity and timing (average completion: 9.5 minutes).

Participants first rated their baseline familiarity with several clean energy technologies (e.g., solar, wind, hydropower, nuclear, natural gas with CCUS, and geothermal). Then, energy-source attributes—affordability, reliability, low climate impact, accessibility, human and ecosystem safety, job creation, and minimal landscape disruption—were assessed using a weighted salience index (Sutrop, 2001), combining selection frequency and rank order to determine importance.

The dependent variable, social acceptance, was computed as the mean of two five-point Likert items (favorability and comfort; Cronbach's α = 0.85–0.89) to obtain a composite measure. Six predictors—familiarity, subjective norms, perceived benefits, perceived fairness, environmental impact, and perceived risks—were analyzed using hierarchical linear regression. Model 1 included key predictors, and Model 2 added trust and control variables. All assumptions were met (VIF < 2.5). Analyses were performed in IBM SPSS Statistics 30.0.

2. RESULTS AND DISCUSSION

2.1. Sample Overview

The sample was broadly representative of the adult populations of Alberta and British Columbia. Gender distribution was nearly equal, and age and income groups approximated provincial census patterns. Most respondents held post-secondary education and lived in urban or suburban areas. Ideologically, Alberta respondents tended to lean more conservative, particularly on economic and environmental values, whereas British Columbia respondents leaned more progressive, especially on environmental principles.

2.2. Energy-Source Attributes and Familiarity

Across both provinces, affordability emerged as the most important energy attribute, followed by human safety and reliability (Figure 1). These priorities show that people value cost, health, and supply security as non-negotiable conditions they expect from any energy technology (Moore, 2015; Aklin, 2021). Rising costs can quickly erode approval, even for low-carbon options (van Rijnsoever & Farla, 2014; Boyd et al., 2019). Provincial differences were modest but meaningful. British Columbians placed greater emphasis on ecosystem safety and low climate impact, consistent with the province's environmental orientation, whereas Albertans prioritized job creation, reflecting economic concerns. Accessibility and landscape disruption ranked lowest, suggesting that aesthetic or logistical issues matter less than affordability, safety, and reliability. Together, these findings reaffirm that secure, affordable, and dependable energy remains central to Canada's social contract.

Baseline familiarity with energy sources also varied across technologies. In both provinces, respondents reported the highest familiarity with solar energy (M = 3.3–3.4) and the lowest familiarity with geothermal energy (M = 2.5). Alberta participants were slightly more familiar with wind power and natural gas with CCUS, whereas respondents in British Columbia reported greater familiarity with hydropower, reflecting each province's energy infrastructure and policy context (Boyd et al., 2019). The relatively low familiarity with geothermal suggests limited public exposure to the technology, consistent with international findings (Dowd et al., 2011). Such unfamiliarity increases skepticism and uncertainty, implying that improving public understanding is essential to strengthening support.

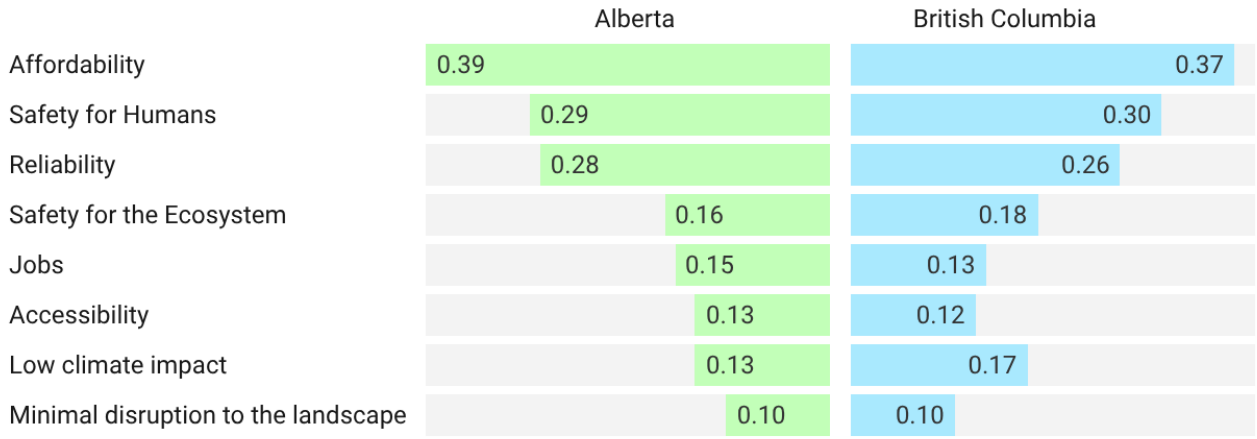


Figure 1. Relative importance of energy-system attributes in Alberta and British Columbia based on the Sutrop salience index. Salience scores are calculated using the Sutrop index $S = F / (N \times m P)$, where F is the frequency of selection, N the number of respondents (AB = 1,301; BC = 1,302), and mP the mean rank position. Values range from 0 (never selected) to 1 (always selected first).

2.3. Social Acceptance and Key Predictors

Social acceptance of geoexchange, hydrothermal, and UDGS was moderate in both provinces, ranging from about 3.0 to 3.5 on a five-point scale, indicating cautious openness rather than full endorsement.

Regression results (Figure 2) show that subjective norms and perceived benefits were the strongest predictors of acceptance in both Alberta and British Columbia, consistent with behavioural models of energy technology acceptance (Huijts et al., 2012; Renoth et al., 2023). Acceptance increased when respondents believed that important social circles supported geothermal systems or expected tangible advantages, such as a reliable energy supply and lower energy costs. Familiarity and perceived fairness showed smaller but positive effects, reflecting the role of knowledge and perceived procedural justice in shaping energy acceptance (Huijts et al., 2012; Wüstenhagen et al., 2007).

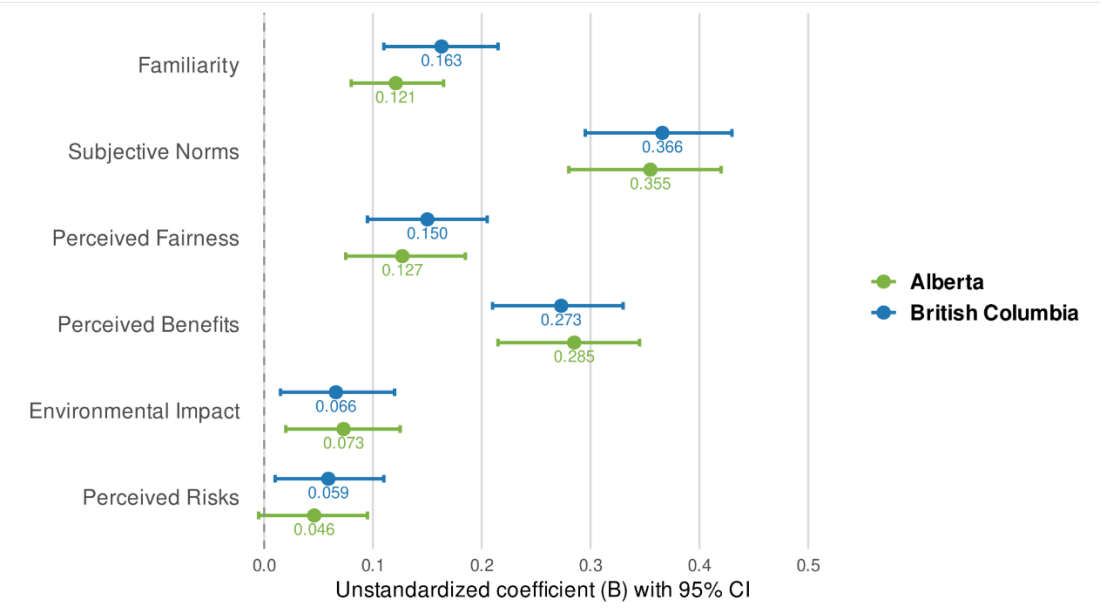


Figure 2. Key Predictors of Social Acceptance of Geothermal Systems in Alberta and British Columbia. Unstandardized regression coefficients (B) with 95% confidence intervals from hierarchical linear regression models predicting social acceptance of geothermal systems. Positive coefficients indicate stronger support associated with higher predictor values.

By contrast, environmental impact and perceived risks had comparatively weak effects. Although geothermal was often viewed as environmentally beneficial, concerns about risks, such as induced seismicity or technical failure, were not strong determinants of acceptance once perceived benefits were considered.

Overall, the results indicate that expected benefits and social endorsement are the primary drivers of geothermal acceptance, while knowledge and procedural fairness play secondary roles, consistent with behavioural models of technology acceptance (Gumasing et al., 2023; Huijts et al., 2012).

Adding trust and contextual variables slightly improved model fit (ΔR^2 = 0.03–0.06). Trust in scientists and universities was positively associated with acceptance, highlighting the importance of credible expertise in shaping public attitudes toward energy technologies (Liu et al., 2019), whereas demographic and ideological influences were generally modest.

3. CONCLUSIONS

This study provides the first comparative analysis of social acceptance of geoexchange, hydrothermal, and UDGS systems in Alberta and British Columbia. Results show that affordability, safety, and reliability are the core attributes shaping how respondents evaluate energy technologies, while geothermal remains the least familiar technology among those assessed.

Despite this low familiarity, acceptance of geothermal systems was moderate in both provinces, indicating cautious openness to the technology. Regression results further show that perceived benefits and subjective norms are the strongest predictors of acceptance, suggesting that support depends primarily on expected practical advantages and perceived endorsement from social groups. Familiarity and perceived fairness also contribute positively, although their influence is smaller.

Together, these findings indicate that expanding geothermal energy in Western Canada will require clear communication of benefits, transparent decision-making processes, and credible scientific engagement. Increasing public familiarity and demonstrating tangible value may help move geothermal from a relatively unfamiliar technology toward a more visible contributor to Canada's clean-energy transition.

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