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"Wind energy is not an issue for government": Barriers to wind energy development in Newfoundland and Labrador, Canada

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ABSTRACT

Despite having amongst the strongest potential for wind energy development (WED) of any jurisdiction in North America, the Canadian province of Newfoundland and Labrador (NL) remains dependent on fossil fuels for economic activity, government revenue, as well as electricity generation. The study is a comprehensive assessment of barriers to renewable energy development in NL, with a focus on wind energy. While NL is chosen as the primary case study, the study's theoretical breadth provides insights for other renewable energy (RE) development and policy contexts as well. Seventeen semi-structured expert interviews were conducted with respondents from academia, community groups, government, and the private sector. An analytical framework was employed and directed content analysis was utilized. A large majority of expert respondents (65%) classified the current state of WED in the province as 'unfavourable'. In total, 19 unique barriers were identified; the most significant barriers to WED were found to be political (71% of respondents), economic (65%), as well as related to lack of knowledge and agreement (53 and 41%, respectively). The study demonstrates that there is no single barrier to the development of RE sources; as such, comprehensive policy solutions comprised of financial, educational, legislative, and consultative components are required.

1. Introduction

Carbon-intensive fuel sources continue to prevail as the world's leading supply of energy. Coal, oil, and natural gas supply approximately 82% of the global primary energy needs according to the International Energy Agency (IEA, 2015). The Intergovernmental Panel on Climate Change ([IPCC] 2007) has concluded that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level". Furthermore, the most recent IPCC report (IPCC, 2014) states that "it is extremely likely (with 95–100% certainty) that human influence has been the dominant cause of the observed warming since the mid-20th century", most significantly, due to the burning of fossil fuels in transportation, generation of electricity, and operation of homes and businesses.

Research suggests that in order to maintain the atmospheric carbon concentration target of 450 ppm, global emissions must be reduced by up to 50% compared to 1990 levels. This implies emissions reductions in developed countries of 60–80% by 2050 (Weaver et al., 2007). Many researchers have promoted the idea of developing renewable energy sources as a means to achieve emissions reduction targets (Muis et al., 2010). However, many barriers to renewable energy development remain (Mey et al., 2016; Richards et al., 2012; Krupa, 2012; Jagoda et al., 2011; Musial and Ram, 2010; Sovacool, 2009; Oikonomou et al., 2009; Reddy and Painuly, 2004; Jagadeesh, 2000).

Newfoundland and Labrador (NL), Canada's most easterly province, serves as the case study for the current research. Despite having substantial renewable energy potential, the province remains dependent on the production and consumption of fossil fuels. For example, in 2009, oil royalties accounted for 31% of the provincial governments total revenue (Canadian Association of Petroleum Producers, 2010). As such, fluctuating oil prices severely impact the NL economy; for every dollar drop in the yearly average price of a barrel of oil, the provincial treasury loses approximately $30 million in revenue (Bailey, 2014). A single oil-fired power plant, the 490 MW Holyrood Thermal Generating Station, provides upwards of 30% of the provinces electricity needs on an annual basis (Department of Natural Resources, 2012). Furthermore, approximately 25 off-grid communities in the province rely exclusively on diesel generators – consuming over 15 million litres

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of diesel fuel annually (Jones, 2010). While the province relies on large-scale hydroelectric power for approximately 65% of its electricity, not including the 824 MW Lower Churchill Project (Muskrat Falls) currently under construction, a considerable body of research suggests that large-scale hydroelectric developments have significant ecological and social impacts (Jackson and Barber, 2016; Rosenberg et al., 1995).

Conversely, the province has amongst the strongest potential for wind energy development of any jurisdiction in North America (Government of NL, 2007). For example, Fisher et al. (2009) have calculated that on an annual basis, NL is theoretically capable of producing 117 times the amount of its 2006 electricity demand through wind energy. Barrington-Leigh and Ouliaris (2017) have concluded that "[NL] could generate almost 20% of Canada's 2010 energy demand by making use of only 25% of its high potential [wind development] area" (p. 21). NL's Department of Natural Resources (2005) provides a conservative estimate of 5000 MW of wind energy available for development. Despite this significant potential, NLs 55 MW of installed wind energy capacity is ranked last amongst Canada's provinces (Canadian Wind Energy Association [CWEA], 2015). There are few studies analyzing NL's fossil fuel dependence or wind energy potential. Existing research in a NL context concentrates solely on engineering aspects or the technical feasibility of renewable energy development (Fisher et al., 2009; Blackler and Iqbal, 2006; Jewer et al., 2005; Khan and Iqbal, 2004), despite the fact that numerous non-technical barriers to renewable energy exist (Zhao et al., 2016a; Owen, 2006; Beck and Martinot, 2004; Reddy and Painuly, 2004).

In the study, barriers to renewable energy development in NL are explored with a focus on wind energy. The research method involved a series of 17 semi-structured/open-ended expert interviews. Expert respondents were drawn evenly from academia, government, the private sector, and environmental non-governmental organizations (ENGOs). The research was organized using Trudgill's AKTESP framework (1990), which focuses on agreement, knowledge, technological, economic, social, and political aspects of wind energy development. The study argues that transitioning to renewable sources of energy in the province of NL is a complex and difficult process – often impeded by several individual and interrelated barriers. Comprehensive policy solutions involving consultative, educational, legislative, and financial components are needed in order to encourage the transition to renewable energies. The results of this research will assist policymakers and other relevant stakeholders in making informed energy-related decisions and in targeting future research and development efforts.

The paper is organized as follows. First, the paper includes a brief literature review of relevant technological innovation literature, and a discussion of the data collection and analysis processes. Secondly, the paper overviews the data collected, followed by a full discussion and interpretation of the results. Finally, the paper includes a short conclusion – which includes limitations, recommendations for future research and policy implications.

2. Literature review

There are many theoretical frameworks appropriate for analyzing the development and diffusion of technical innovations systems [TIS]; these include, but are not limited to, the national innovation systems framework (Nelson, 1993; Lundvall, 1992), the technological innovation systems framework (Edquist, 1997; Freeman, 1987), and the socio-technical regime theory (Smith et al., 2005; Geels, 2004). It is beyond the focus of this article to provide an in-depth understanding of these theoretical frameworks; however, it is important to acknowledge that the various transition theories mentioned above "analyze the development and diffusion of new technologies by examining the actors of a particular technological regimes, the networks through which they interact and the institutions that set the framework under which technological transition takes place" (Eleftheriadis and Anagnostopoulou, 2015, p. 154). These theories explain the success or failure of a TIS on the basis of structural components – consisting of (1) actors from the public and private sectors such as firms, government, research bodies, and advocacy groups, (2) the networks where they interact, and (3) relevant institutions (norms, regulations, and laws) (Eleftheriadis and Anagnostopoulou, 2015). The systems function concept has also been proposed to study the diffusion of TIS (Bergek et al., 2008; Hekkert et al., 2007; Negro et al., 2007); here TIS are investigated using a set of specific functions including: entrepreneurial activities/experimentation, knowledge development and diffusion, guidance of the search, resource mobilization, market formation, and legitimization and development of positive externalities. The barriers to transformation can be identified by analyzing each specific function (Eleftheriadis and Anagnostopoulou, 2015).

Bergek et al. (2008) explain that for an emerging TIS, there are considerable uncertainties in identifying structural components; for example, it may be difficult to identify relevant actors, networks are typically underdeveloped and/or informal, and there may be a lack of TIS-specific institutions (p. 414). Furthermore, these authors argue that identifying structural components forms the basis for analyzing TIS in the previously mentioned set of functions. It is rather difficult to identify structural components in NL's emerging wind energy sector, suggesting that these frameworks may not be the most appropriate for the current investigation. As previously discussed in Section 1, NL is ranked last amongst Canada's provinces in installed wind energy capacity. As such, there is a limited number of firms, government agencies, NGOs, or research bodies, directly involved in the development or diffusion of wind energy in the province. Further complicating matters, the provincial government has enacted legislation (*Bill* 61) which maintains a monopoly over power production and distribution in the province to the two existing electrical utilities (47th General Assembly, First Session, 2012).

Due to the difficulty in identifying/analyzing the structural components (actors, networks, institutions) involved in NL's emerging wind energy sector, the research project sought a broader analytical framework which would enable an understanding of barriers to wind energy development in the province. The research drew on a methodology successfully implemented by researchers in a similar Canadian jurisdiction; Richards et al. (2012) implemented Trudgill's (1990) 'AKTESP' Analytical Framework in their investigation of barriers to large-scale wind energy development in Saskatchewan. Saskatchewan's energy sector maintains similar characteristics to NL's, in that it is highly dependent on the consumption of fossil fuels, and possesses significant untapped wind energy potential (SaskPower Environmental Programs, 2009; SES, 2007). Electricity generation in both provinces is dominated by a single Crown energy corporation (SaskPower and Nalcor/NL Hydro, respectively). Similar to NL, Saskatchewan ranks third last amongst Canada's provinces in installed wind energy capacity (CWEA, 2015). These common factors and successful implementation by Richards et al. (2012) suggests that the AKTESP Framework would be useful in explaining barriers to renewable energy diffusion in NL. Furthermore, the 'AKTESP' Framework has proven its versatility in helping to explain a diverse array of environmental challenges, including Amazonian deforestation (Trudgill, 1990), cumulative effects assessment (Piper, 2001), cultural landscape conservation (Selman, 2004), and public resistance to solar energy (Haw et al., 2009).

Trudgill (1990) identified six major groups of barriers to achieving a better environment: agreement, knowledge, technological, economic, social perception, and political will **(**Fig. 1**).** Trudgill (1990) argues that if there is a barrier along the framework (i.e. key actors disagree on the problem at hand, inadequate knowledge exists to understand the problem, technological solutions are underdeveloped, solutions are not economically viable, the solution lacks social acceptance, or there is a lack of political will to pursue a solution, etc.), environmental solutions may not be achieved. The study implements Trudgill's (1990) 'AKTESP' framework for analysis in order to organize and analyze empirical evidence and to guide the discussion of barriers to