Determining the Affordability of a Green Energy Transition in British Columbia

Valerie Chang
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Executive Summary

Canada has an almost notorious reputation for being environmentally unfriendly in the global context. From being the first nation to withdraw from the Kyoto protocol in 2011, to ranking last out of 27 wealthy countries in environmental protection, Canada has partially lost its all-round likable status. This has made numerous environmentalists eager to actualize a program where renewables would become the dominant energy source. However, cost is always at the top of the list of issues. The purpose of this paper is to determine whether it is practical to duplicate an energy transition in British Columbia, such that is currently being practiced in Germany. More specifically, would such a transition be affordable to BC’s government, to home owners, and to power companies, and would it also create jobs?

Through research of scholarly sources, this study finds that it is impractical for such an energy transition to be executed; however, if only the financial aspect is analyzed, it is possible for an affordable green energy transition that also creates jobs to be implemented in BC. Some recommendations if the results of this paper is to be acted upon, are to first test the program in a medium-sized city, to reduce consumption while also increasing dependence on renewables, and to learn from Ontario’s mistakes and resist high initial feed-in tariff rates.

Background: The Energiewende

The German green energy transition, or the Energiewende, was one of the first of its kind, and began in the 1970’s with the anti-nuclear movement, but it was not official until 2011 (Mabee, Mannion, Carpenter, 2012). Since then, it has been quite successful in the transitioning of companies and individuals to not only rely upon, but also generate renewable energy (Rowlands, 2005). The Energiewende is based on the idea of distributed
generation, and although it is a campaign to increase the use of renewables, and therefore includes all renewable technology, there is a focus on solar photovoltaics (PV).

Since Ontario already implemented their own energy transition in 2010, an emphasis in this report is put on the west coast, namely in the province of British Columbia.

**Distributed Generation and Feed-in Tariffs**

A large component of the Germany energy transition is the use of feed-in programs. Based on the idea of distributed generation, where instead of a large central generator of energy, such as a farm of wind turbines, there would be more dependence on smaller generators of energy, such as school buildings or individual homes. Solar PVs have been found to be the most logical option out of all the renewable technologies to achieve this (Mabee, Mannion, Carpenter).

Within this program, energy providers are paid to “feed” in energy into a grid line that is connected to a larger network. Payments, or tariffs, can be in the form of power companies directly paying individuals, or subtracting from their electrical bill. The goal is that contributing houses would hopefully be able to generate enough energy to sustain themselves and be zero-energy buildings (Norton & Christensen, 2008). It is only when a house has generated more energy that it uses, would it then feed into the line and the home owner be paid. The guaranteed payments over a number of years (depending on the length of the contract, which in Germany, is 20 years (Rowlands)) provide investors with sufficient confidence to invest the large sums of money that are initially required in order to construct a renewable energy facility. The more expensive the technology is to manufacture and install, the higher the incentive rates (Tampier, 2002).
There are also secondary benefits to feed-in programs. When renewable energy generating centres are located in more diverse locations, support for renewable electricity can grow and stimulate conversations about sustainability of energy supply (Rowlands).

Method

Through extensive literature review, much information was found about feed-in programs, solar PVs, energy policy, and the economics of renewable energy. Since the question in hand is derived from an already existing program, literature that compared the Energiewende to Ontario’s green energy transition were consulted. Although there are numerous differences between Ontario and BC, the fact that both are under one common federal government suggested some degree of likeness and parallels between the two provinces.

One interview was conducted. Eric Mazzi of the Clean Energy Research Centre at the University of British Columbia, was asked several questions on the topic and he
contributed to the research through cost analysis as well as giving his professional opinions.

Program Feasibility

To begin, it must be mentioned that despite the final conclusion of this research, it was the result of a rather one dimensional study. Indeed, with only the financial aspect of a green energy transition considered, it is found to be sufficiently affordable for all those who are involved. However, when looking at the feasibility of the program as a whole, and including the multiple other factors that should be included to truly consider creating a green energy transition, the future does not seem bright. In a political perspective, the level of practicality of a green energy transition to be implemented now is very low. By 2012, $7.9 billion has been invested into BC Hydro’s plans for the Site C dam to be constructed on the Peace River (Pye). It would be extremely difficult to deter from what is expected to be used with that amount of money (to build the dam) and instead invest it into a system that is essentially the opposite in terms of infrastructure. Also, BC Hydro prides itself in generating electricity that is over 90% renewable (BC Hydro, 2012), and again, it would be difficult to convince the benefits of investing in a new energy transition instead of continuing with what has been the case for decades, especially when they would profit less, due to decreased dependence. The goal of the future would be to somehow decouple economic growth from the rising supply of [primary] energy (Smil, 2003).

Cost of Solar Photovoltaics in BC

The raw cost of solar photovoltaics is the first factor that is analyzed to determine the affordability of such an energy transition program focusing on the use of the technology. However, the cost of solar PVs is difficult to calculate. On one hand, the cost of electricity is increasing but on the other hand, the cost of solar PVs is decreasing. At the global scale, the cost of PVs have fallen from approximately $100/watt in the 1970's to
roughly $1/watt in 2012, and predicted to cost less than 10¢/watt Canadian by 2020 (Pye, 2012). Given this, the two costs may intersect, and projection assumes grid parity (when alternative sources of energy generates at a levelized cost that is equal to or less than the purchasing power from the electricity grid) could be reached as early as 2027 for residential and commercial systems, and as early as 2024 for utility systems, as shown in figure 2. The graph shows the increasing level of rates customers would have to pay if they were to continue paying the power company as they were, and yet the cost of building and operating the electrical technology (LCOE: “levelized cost of energy”) is decreasing. Therefore if one were to build and operate his or her own personal electricity generator, it would be cheaper than to pay the electrical rates over the economic lifetime of the technology. However, solar PVs are currently still the most expensive energy source, renewable or non-renewable (Zhao, 2011).

![Figure 2. Projected decreasing levelized cost of energy by solar PV and increasing electricity rates (Pye, 2012)](image)

Currently, BC Hydro charges their customers 7.52¢/kWh for the first 1,350 kWh they use over an average two-month billing period. When they use more than that amount,
customers pay 11.27 cents per kWh for the balance of the electricity used during the billing period (BC Hydro, 2014). In addition to these rates, residential customers have to pay a basic charge of 15.05 cents per day to account for the fixed cost of energy generation (Pye). The levelized cost of energy must be calculated to compare the cost of solar PV energy to electricity rates. It has been predicted that system prices will annually decrease by 5% and electricity tariffs will increase 2.15% (Branker, Pathak, Pearce, 2011).

The price of solar PVs is driven by four cost elements: modules, balance of system components, labour costs, and soft costs. In Canada, the cost of modules, which are the panels themselves, has dropped 30% since 2005, and is expected to drop an additional 55% by 2025. In 2012, the retail module prices were between $1.30 and $1.80 per watt. The balance of systems costs is largely dependent on the price of inverters. Inverters are crucial to the system as they convert direct current output of a PV solar panel into alternating current, which is the required current to have usable electricity. The lowest reported retail priced inverter is $0.71/watt, however other sources claim that a higher capacity inverter (2000 watts or larger) has even lower prices, as low as $0.55/watt. With this, the idea of purchasing a higher capacity inverter may be more popular, even though one may not need such a large capacity, simply to pay the lower price.

Any hourly paid labour positions related to energy or energy maintenance have a minimum wage of $20, depending on the regional rate. Of course, the larger the scale and the more complex the manufacturing process and maintenance of a technology, the more workers are required, and more people to pay. In addition to this fixed rate, added cost of overhead expenses such as company vehicle use and maintenance is also considered. Again, the smaller systems are at the bottom end of the deal, as the overhead expenses are highest for residential at roughly 50% of total labour costs, and lowest for utility sized installers, at rough 22% of total labour costs. However, it should all balance out, as residential systems are much smaller than utility sized systems. Soft costs are essentially
indirect costs, which include paying for permits and net metering permits to have a renewable technology to be installed at a residence (Pye).

In recent years, China has leapt past several European and North American countries to be the leading country in photovoltaic production. Their mass production capacity and increasing domestic demand and use of the technology has made China able to produce PVs at a very low cost (Zhao). For BC, however, this cost is offset by the high-priced expense of shipping the solar PV panels. This trade-off of financial versus environmental cost must always be accounted for. No specific numbers can be acquired for calculations, but the combination of shipping costs and environmental costs deems domestic production more favourable.

Creating Jobs

The renewable energy sector produces more jobs per dollar invested than dollars invested in fossil fuels, as well as per unit of energy delivered. Among the renewable power source technologies, solar PVs create the most jobs per unit of electricity (Tampier), although this is not necessarily exclusively through the implementation of feed-in programs. This high rate of employment is due to the manpower required to manufacture the technology, as well as the high level of maintenance required over a long period (Pollin & Gerret-Peltier, 2009). However, regardless of the amount of workers needed, the budget for paying them will limit the number of employees that are hired.

Taking studies from Ontario, there are some employment effects from job investment projects, that would just as easily apply to BC. Direct effects include the jobs that are created by the targeted activities, such as demand and conservation management; indirect effects include the jobs that are associated with industries that provide goods and services to green activities; and induced effects include employment creation that results when people are paid through green investment projects (Pollin & Gerret-Peltier).
Homeowners’ Affordability

The affordability of a green energy transition to individual homeowners is conditional upon numerous factors. Indeed, the initial installation costs are in the thousands, regardless of the scale, but essentially, as long as there are incentives and subsidies, either from the involved power company or the government, most homeowners can afford to participate in the energy transition (Wong, 2010). This is where feed-in tariffs become useful. If BC were to follow Germany with a 20 year long contract, that time period, along with the back payment rates, should be enough for participants to break even on the cost of their installed renewable technology (Mazzi).

The number of solar panels needed to power a home depends on the size of the home, more specifically, the surface area of the roof. The average home (by size, is estimated to accommodate 4 people) would required a 5kW system at minimum. 5 kW systems, which generate at least 5,500 kWh a year, have been estimated to perform more efficiently than a 1.5 kW and will cost anywhere from $15,000 to $17,000, depending on the manufacturing company (Pye). Although this does not seem affordable, by the raw prices, these costs do not have to be paid in full all at once. Organizations such as SolarBC, which was created by the British Columbia Sustainable Energy Association with BC Ministry of Environment, helps make affordable solar technology a reality for homeowners. SolarBC aides the province’s residential, educational, and institutional sectors, as well as First Nations’ communities by creating projects that give incentives (Salsberg). They are proven to be very significant in the spread of solar panels in First Nations’ communities, demonstrating the evidence of its affordability.

Power Company Affordability

The biggest factor that determines the affordability of a green energy transition for power companies is the predicted increase of employment as well as program payment
rates. An idea mentioned multiple times in this paper is the demand for more employees, whom the companies have to pay. Undoubtedly, they cannot hire more than they can pay and still make a profit. Also, the feed-in program rates must be high enough to be a persuasive incentive, yet companies must also make sure the amount of energy that distributed generators feed to them can be sold at a higher rate to other consumers.

This is absolutely possible, with the aide of government funding and energy policies. By being an intermediate stakeholder, with slightly less at stake (financially) than homeowners, government aide is more stable for BC Hydro, which is a crown corporation. In fact, the application of energy policies can even expand an industry. Governments can improve the competitiveness of domestic markets on world markets by connecting energy policies to research and development processes and therefore accelerate commercialization of renewable technologies (Lund).

The provincial power company at hand here is of course BC Hydro. They were reluctant to answer most questions concerning an energy source shift, and strongly defend that the energy they generate is already over 90% renewable, regardless of whether the alternative option is affordable or not. This was a case of “why fix something that isn’t broken.” As a result, this section was the least certain in affordability (to power companies, but specifically, BC Hydro).

**Government Affordability**

Since both power companies and homeowners depend on funding from the government, it truly is a question of whether the government can afford a green energy transition. One way to know that it can, is to ensure province-wide participation (Mazzi); in a way, if everyone is involved, the conventional sources of energy would become obsolete, and so an energy transition would not only be successful, but mandatory. Therefore, what should be focused on is the promotion of renewable energy, which is found to be most successful through enforcing policies.
The system of renewable portfolio standard (RPS) obligates all power suppliers to have a certain percentage of electricity they generate to be from renewable resources (Rowlands). With BC’s set goal of 93% renewable portfolio standard, gearing towards electricity self-sufficiency by 2016 (Sopinka, van Kooten, Wong, 2012), this can ensure energy generators and companies can grow so that subsidies and incentives would no longer be needed.

**Conclusion**

Through this study, it has been established that there are many complications to truly determine whether a version of the Energiewende would be affordable in BC. Nevertheless, sufficient energy cost and energy trends have been presented to claim that prices will be low enough for an energy transition to be affordable, if all the stakeholders are willing and committed to take some leaps of faith and make investments. The prediction of energy grid parity assumes everything will continue as it were, and no drastic even would occur that would change the current trends. Therefore, the idea of grid parity in the near future is unstable. The mere introduction of a supported program for renewable energy acts as a new company, which undoubtedly needs workers, and therefore will create jobs. Finally, policies are crucial to the overall affordability of an energy program to the province, and must be enforced for all involved parties.

**Recommendations**

To avoid the large initial investment by the government or BC Hydro, I propose to implement the program in a city first, then expand to the region that city is a part of, and then expand to the rest of the province. This chosen city would act as a test city, and should be of medium population- not as large as Vancouver, but certainly not as small as Bella Coola- so that when the program expands, it would be a fair enough representation of all cities.
My second recommendation would be to combine the goal to reduce consumption with increasing dependence on renewables (and decreasing dependence on fossil fuels). Most literature that has the purpose of promoting sustainability either encourages reducing consumption as the solution, or to switch to renewables. The latter, however, justifies the amount of energy people consume. Therefore, if we work to reduce consumption, not as many PV panels are required and less money would be spent on the technology, or less energy is required to be generated for a building to be closer to zero energy. Essentially, this would increase the efficiency of the technology and make renewables more viable (Mazzi).

My last recommendation is to take advantage of the fact that Ontario tried its own every transition first, and to learn from their mistakes. Not much was said about the green energy transition in Ontario. However, Ontario Power Authority has been reported to give very high incentives to recruit as many people as possible to participate in the program. In order to pay these high rates, they charge all other customers who are a part of their system, but not in the program. If BC were to actualize a green energy transition, the province must remove the disincentives that lie within the incentives, so that all citizens are fairly charged.

Future Research

This paper was heavily based on literature research; however, the topic called for some information from the power company themselves. Due to some legal issues and lack of certainty in part of the power company, interviews with BC Hydro could not be conducted. In the future, however, if the opportunity rises, discussions with a company representative should be performed. A more extensive mathematical approach to the question is suggested for the future as well. Comparisons between income and PV cost over a period of time (length of program contract) could be conducted to statistically predict affordability. For the lack of time and space, information about other types of renewable
technologies were excluded, but should be mentioned for future discussions on the topic. Lastly, a large scale distribution of surveys could be done in Ontario in order to collect more accurate opinions on the affordability of their green energy transition, and perhaps apply it to British Columbia.
References


