# Assessment of the Export Potential of Wind Turbines to Nepal

Elizabeth Crowther

Friday 2:30 PM

AGR 1110

Monday, November 30, 2015

This paper refers to a product that could be exported from Canada to Nepal to help Nepalese farmers sustain their farms and provide food for their families. The product chosen is a low cost wind turbine. Worldwide, wind energy is one of the fastest growing sources of new electricity (Why Wind Works: Wind Energy in Canada , 2015). Wind energy is pollution free, reliable, safe and cost competitive when compared to other types of energy (Why Wind Works: Wind Energy in Canada , 2015). One modern wind turbine will save over 4,000 tonnes of $CO_2$ emissions annually, which is important in today's society when climate change is becoming increasingly severe (Why Wind Works: Wind Energy in Canada , 2015). Creating energy for Nepalese societies should not be detrimental to the rest of the world (Wind Energy Facts, 2015) Agriculture relies on the weather and climate to be successful so is it especially vital to introduce forms of energy to developing countries that will help keep our world clean and sustainable (Wind Energy Facts, 2015).

## Part I: Information pertaining to product and impact on Canada

### i) Product

The wind turbine chosen for export is the Eocycle 25, a wind turbine that represents the next generation of the wind energy industry, bringing the most recent technology developments to small scale wind customers (The Eocycle 25, 2012). This safe, durable turbine generates the best return investment of all turbines in its class (The Eocycle 25, 2012). The Eocycle 25 has lower rotor speeds then most turbines, which results in savings up to 35-60% (The Eocycle 25, 2012). This turbine is composed of top quality components, and uses a simple driven design which brings maintenance costs down, as well as prolongs any maintenance needed after installation (The Eocycle 25, 2012). The Eocycle 25 is programmed to consistently monitor wind conditions, giving the model excellent energy efficiency, which is beneficial to farmers in Nepal

who do not have a lot of money (The Eocycle 25, 2012). This 36 foot tall turbine, with 12.6m blades, allows for crane less installation, which is crucial in a country such as Nepal that may not have access to such equipment (The Eocycle 25, 2012).

**Fig 1: Eocycle 25 Wind Turbine (Niagarawind.com, 2015)**

### ii) Where Product is Made

The rights to make every component of this wind turbine including their own specialized generator technology, is owned by Eocycle Technologies (Company and Markets, 2011). It is a company based out of Quebec, Canada that sells develops, manufactures, and commercializes small wind turbines worldwide (Company and Markets, 2011). Eocycle Technologies has a team of world class engineers and installers that design the turbines as well as a professional installation team, which installs turbines efficiently and properly (Company and Markets, 2011). This company has been established for decades and has made strong connections with North American and European partners and suppliers (Company and Markets, 2011).

The distributed wind energy (DWE) market is growing steadily, and will continue to do so over the next few years (Company and Markets, 2011). About 200 MW of capacity was installed in 2013, and by 2020 is expected to reach 1000 MW (Company and Markets, 2011). Thanks to Eocycle 25's flexibility and adaptability, this turbine can be used in the agricultural sector, such as farms, ranches, and vineyards, as well as in residential, business, and educational or governmental sectors (Company and Markets, 2011). Remote region's (off grid) electrical needs can also be satisfied by this turbine, by producing electricity in areas never possible before (Company and Markets, 2011).

### iii) Machinery/Labour Required and Cost

All machinery needed for this turbine is supplied by Eocycle Technologies, where the product is being manufactured (Company and Markets, 2011). A 1kW-2kW turbine can cost about 800$ and up, which would power about one Canadian home with sufficient electricity (Cost of Wind Turbine , 2013). Since the Eocycle 25 is a 25kW turbine, it could power over 25 homes, as one would assume Nepalese people would not use near as much electricity as people in North America, due to the fact that they do not many appliances that run on electricity (Cost of Wind Turbine , 2013). That being said a 25kW turbine, like the one being exported to Nepal would cost upwards of $30 000 (Cost of Wind Turbine , 2013). On top of this cost would be the installation fee, which would include paying the installation team as well as their airfare to get to Nepal to set these turbines up (Cost of Wind Turbine , 2013). Flying the installation team out of Montreal, Quebec to Kathmandu, Nepal could easily cost over $10 000 for the round trip (Departure to Kathmandu, 2015). Cables, connections to the grid, and turbine foundation would be additional costs as well, as some villages in Nepal would have no distribution set up

previously for the electrical current to be stored, and spread to different customers (Cost of Wind Turbine , 2013).

### iv) Wind turbine health information

There is much controversy over the safety of human health when it comes to wind turbines (Suzuki, 2013). Some residents living near wind turbines complain of headaches, nausea, and a constant audible hum from the blades turning (Suzuki, 2013). Many scientists have proved that wind turbines do not negatively affect human health in any significant way (Suzuki, 2013). If wind turbines were to be shipped to Nepal, the farmer's permission would have to be given before installation began, although one would assume that Nepalese people would be more grateful for the source of energy and not as concerned with other consumer's claims (Suzuki, 2013).

### v) Patent/Intellectual Property Constraints

In the United States, permits for wind turbines vary considerably between state to state (Permitting Basics, 2015). For example, in Illinois wind turbines are only permitted for "special uses" in areas deemed solely for agriculture, while residents in Iowa have no codes of restriction besides the existing requirements for planned development such as structure height (Permitting Basics, 2015). If permits were necessary for wind turbines in Nepal, they would go through the National Energy Strategy (NES), and one would assume they would be passed fairly easy, as this group is looking for any ways to get electricity throughout Nepal and other developing countries (Nepal Energy Situation, 2015).

### vi) Niche Product and Large Population Product

According to estimations of the Nepal Energy Authority (NEA), energy demand in Nepal will grow with an average annual rate of 8.34 %, for the next 17 years (Nepal Energy Situation,

2015). In the rural areas of Nepal, 17 million have no access to electricity for various reasons such the unaffordability, land space, and equipment (Nepal Energy Situation, 2015). Due to this, wind turbines would be expected to appeal to a niche population in Nepal (Nepal Energy Situation, 2015). Only villages who all came together to come up with the costs of purchasing and installing a turbine would be able to afford to buy the Eocycle 25, or a small portion of the Nepalese population in the urbanized areas of Nepal may be able to cover the costs (Nepal Energy Situation, 2015). Wind turbines bringing readily available electricity would create positive change to Nepal, but some sort of funding programs from the government or donations would have to be made for this project to undertaken successfully (Nepal Energy Situation, 2015).

### vii) Benefits to Canada

Exporting wind turbines from Canada to Nepal would benefit Canada in many ways. Suppliers and companies such as Eocycle Technologies would become even bigger successes then they have already proved to be (Company and Markets, 2011). Money would be brought into the country through the purchasing of the turbines, as well as many jobs would be created. Engineers will be continually needed to keep inventing new ways to make wind turbines even more efficient, affordable and beneficial to Nepal. The installation team from Eocycle 25 would also need to expand, and employ dozens more technical crew members that would be willing to travel to Nepal. More people may consider getting jobs in the trades, an area lacking in today's society, to become wind turbine technicians.

Canada also would have very important chances to make crucial partnerships within the industry, government, universities, research institutes and testing facilities (Renewable Energy , 2015). As Canada is a world leader in renewable energy, other countries may want to join the

country in producing wind turbines and other sources of cleaner energy (Renewable Energy , 2015). Due to Canada's strong renewable energy industry other foreign investors besides Nepal may want to join in on the project as well (Renewable Energy , 2015). All aspects of our countries wind energy industry are important and valuable to other countries, like the technology development and supply to energy generation, as well as distribution and storage (Renewable Energy , 2015).

Canada is the sixth largest consumer of electricity in the world, so we are a great country to be supplying other developing countries the tools they need to be able to harness electricity in renewable and efficient ways (Renewable Energy , 2015). The wind industry is only going to continue to grow in our country, and should be in others as well to keep our world healthy (Renewable Energy , 2015).

Other sectors of business would benefit from the exportation of wind turbines to Nepal (Brown, 2012). The transportation of the turbines from Eocycle Technologies, to the airport would employ even more Canadians (Brown, 2012). Wind turbines are usually split into three pieces, and everything from trailers, escorts, and trucks are needed to transport these turbines (Brown, 2012). Drivers and people who are educated in the process of moving large equipment would be employed in these areas, which would also help Canada's unemployment rate rise (Brown, 2012). About 30% more jobs are created through the wind energy industry compared to coal and nuclear power plants (Brown, 2012).

### viii) Environmental Sustainability

Wind energy is very environmentally sustainable, as it releases no toxic emission and is a very clean form of making electricity (Benefits of Renewable Energy Use, 2015). Producing electricity accounts for over one third of the United States global warming emissions (Benefits of

Renewable Energy Use, 2015). Coal-fired or natural-gas fired power plants release greenhouse gases which have devastating effects on the environment (Benefits of Renewable Energy Use, 2015). Increasing the use of renewable energy, specifically wind energy, would help decrease the climate change that is happening globally (Benefits of Renewable Energy Use, 2015).

Wind energy can be sustained almost infinitely (Pros & Cons of Wind Energy, 2015). The sun powers the wind, and wind powers turbines so as long as the sun exists, wind energy will be available to harness (Pros & Cons of Wind Energy, 2015). Water is also saved through the use of turbines, as nuclear and coal energy require about 500-600 times more water to produce the same amount of electricity (Pros & Cons of Wind Energy, 2015). After just nine months of one turbine operating, enough clean energy will be produced to offset the amount of greenhouse gas emissions it took to manufacture, install, and maintenance that turbine (Pros & Cons of Wind Energy, 2015). These are all important issues around the world today, as we strive to keep our plant healthy (Pros & Cons of Wind Energy, 2015). Although turbines are very large, they only take up a very small amount of space when installed, which results in minimal impact on crop production and livestock grazing (Pros & Cons of Wind Energy, 2015).

## Part II: Export Potential of Canadian wind turbines to Nepal

### i) Transportation Logistics

As mentioned earlier, the Eocycle 25 would be manufactured and shipped out from Eocycle Technologies which is located in Anjou, a borough of the city Montreal, Canada. The turbines would be transported from Eocycle Technologies, to the Montréal-Pierre Elliott Trudeau International Airport. This is about a thirty minute drive. The turbines would have to transport in separate large trucks, containing the base, middle and top pieces (Brown, 2012). A highway escort patrol would be required to drive behind these trucks, in accordance with the local laws

(Brown, 2012). Additional trailers and escorts would be required for the blades of the turbine. Permits and specialized equipment would also need to be coordinated to safely move these structures (Brown, 2012).

Large cargo planes would be required to fly these turbines to Nepal. It is likely the plane would be flying to Nepal solely for the purpose of transporting the turbines. The pieces of the Eocycle 25 would have to be wrapped securely and passed through inspection by airport staff. The flight from Montréal-Pierre Elliott Trudeau International Airport, to the Tribhuvan International Airport located in the valley of Nepal's capital city, Kathmandu would take roughly 22 hours (Google Flights, 2015).

Eocycle's installation team as well as any members overseeing the project would get to Nepal via a regular passenger airplane (Google Flights, 2015). It would take the crew members a total of 34 hours to get to Nepal, with two layovers (Google Flights, 2015). Boarding at the Montréal-Pierre Elliott Trudeau International Airport, the team would fly with Envoy Air as American eagle for two hours to the John F. Kennedy International Airport in New York where there would be a short layover (Google Flights, 2015). From New York the crew will be in the air for twelve hours aboard Qatar Airlines and have another fourteen hour layover at Doha International Airport, in Doha, Qatar (Google Flights, 2015). Finally they will take a four hour flight from Doha to Tribhuvan International Airport, in Kathmandu, Nepal (Google Flights, 2015).

From Kathmandu, more trucks would have to be available to transport the turbines from the city to rural villages where turbines were planning on being installed. The turbines would have to be transported via trucks the same way as they were from Eocycle Technologies to Montreal airport. From there, the installation team would take over and set up these turbines.

### ii) Cost Price to Profitability

There are many unknowns regarding purchasing and transporting wind turbines from Canada to Nepal, but one can deduce that transportation may cost up to $10 000, passenger flights another $10 000, the turbine itself is about $30 000, as well as any additional costs that may come up throughout the project. Overall this project would cost well over $50 000, which is an unimaginable sum of money for the average Nepal farmer. For these reasons, this project is not realistic, however because it is such a complex and largescale idea, perhaps government funding and/or donations could be made available. If Nepal received wind turbines it could change the whole face of agriculture for them, and have a major impact on the way they live. This would not be a small project, and could lead to explosive change throughout Nepal and various developing countries.

American consumers who live in states using large amounts of wind energy for electricity generation have found their electricity prices decrease by 0.37% over the past five years (Goggin, 2014). If this project was to actually happen, Nepalese consumers could possible see a profit from purchasing a wind turbine, but incorporating having electricity into their routine agriculture practices which could take many, many years.

### iii) Needs/Benefits to Nepal

Among all the South Asian countries, Nepal has the poorest energy intensity, however it does have a very large energy efficiency potential (Nepal Energy Situation, 2015). Unfortunately Nepal has not taken advantage of its energy potential due to its lack of legal framework, human resources and its low levels of public awareness (Nepal Energy Situation, 2015). If wind turbines were introduced to Nepal some sort of Energy Efficiency Strategy would have to be established that would bring more structure and awareness to the country (Nepal Energy Situation, 2015).

Nepal is a very good country to pick for using wind energy because it has substantial wind speeds, which mean lots of power can be generated (Nepal Energy Situation, 2015). At least 200MW-300MW of capacity is possible, and winds have been reported to being as fast as 46 meters/second (Nepal Energy Situation, 2015). The best sites are in the Mustang district, which are where the more remote agriculture areas are (Nepal Energy Situation, 2015). Overall, Nepal could actually make a substantial amount of money using wind turbines as a form of electricity, and could potentially make a profit over a number of years (Nepal Energy Situation, 2015).

Wind energy is also very reliable, and self-sufficient so Nepal farmers could depend on a steady amount of electricity being received (Adhikari, 2015). If Nepalese farmers could come together as a village and purchase a turbine, many farms could be supplied with electricity from the same turbine (Adhikari, 2015). This would dramatically change the way they could practice their day to day chores, and there life in general (Adhikari, 2015). Once the sun goes down, Nepalese people could actually have light to see in the dark, as well as many of the jobs they do on the farm could be replaced with appliances that run on electricity, overall improving their life quality (Adhikari, 2015). Wind turbines could potentially bring Nepal closer to the standards of a more developed sustainable country (Adhikari, 2015). Parts of the country that already are receiving electricity would now have a cheaper, more reliable system, and off grid rural areas would have access to electricity for the first time ever, changing their life indefinitely (Adhikari, 2015).

Compared to other types of energy sources like biomass, nuclear, or coal, wind energy takes up very little space once installed. The small amount of fertile land Nepalese people currently have would not be wasted (Adhikari, 2015). Some successful farmers may also choose

to purchase turbines and have them on their land that they lease out to other consumers (Adhikari, 2015). They could lease this land out at a higher price than originally, allowing them to have an extra source of income that they desperately need (Adhikari, 2015).

Environmentally, wind energy would also benefit Nepal. Electricity in Nepal is generally generated by biomass and petroleum products. All electricity generation in Nepal is modelled in Table 1 (Nepal Energy Situation, 2015).

**Table 1: Nepal's Top Electricity Producers**

| Primary Energy Sources | Percent of Population Using |
|---|---|
| Biomass | 85% |
| Petroleum products | 9% |
| Coal | 3% |
| Hydroelectricity | 2% |
| Renewables | 1% |

(Nepal Energy Situation, 2015)

These ways of creating electricity release harmful emissions into the atmosphere, and contribute to global warming and climate change (Nepal Energy Situation, 2015). If electricity was generated primarily by wind turbines in Nepal next to no toxic waste, or greenhouse gases would be produced through the generation of electricity, as wind turbines are powered solely by the wind, and are a very clean, safe structure (Nepal Energy Situation, 2015).

### iv) Nepalese companies to be informed

If the biggest businesses in Nepal bought into the idea of wind turbines, a lot of money could be saved in the country. Some of these businesses include Unilever Nepal, Dabur Nepal,

Nepal Battery, and Coca Cola (Sahayogee, 2015). If production in these businesses could produce their electricity solely through the use of wind turbines, very large amounts of money could be saved, which would help keep money in the country. Canadian wind turbine companies such as Endurance Wind Power, and Suncor would also need to be informed of this project, as they could try and come up with even better designs than the Eocycle 25. Transporting companies, and international airlines should also be informed. Potential companies that would be informed of this export idea are provided in Table 2 below.

**Table 2: Information of Canadian Companies to be informed**

| Canadian Company | Type | Address | Phone number |
|---|---|---|---|
| Endurance Wind Power | -wind turbine manufacture | 19347 24 Ave #101, Surrey, BC V3S 3S9 | (604) 579-9463 |
| Suncor Energy Inc. | -wind turbine manufacture | 150 - 6 Avenue S.W. Calgary, Alberta | 403-296-8000 |
| Kriska | Trucking Company | 6424 Danville Rd, Mississauga, ON | (905) 795-2770 |
| Air Canada | Airline company | Multiple locations | 1 (888) 247-2262 |

### v) Canadian government project to get started

If this project were to happen, serious funding from the Canadian government would have to be made available. Global Affairs Canada (GAC) is dedicated to reducing poverty in other countries and works with partners based in Canada to make Canadian efforts more accountable, transparent, and effective (Funding for International Development Projects, 2015). To apply for funding from this government agency a standardized application form must be

completed (Funding for International Development Projects, 2015). All applications must meet the published Assessment Criteria for funding to developing countries (Funding for International Development Projects, 2015).

Other sources of available funding include sending an application to The Canada Fund for Local Initiatives, which is also run by the GAC, and works to put small projects forward that are started by local organizations for developing countries (Funding for International Development Projects, 2015). For university students there is also the International Development Research Centre (IDRC), which provides funding for students and researchers interested in international development research (Funding for International Development Projects, 2015).

### vi) Unknowns

Many of the exact prices for transportation of the wind turbines by truck in Canada and in Nepal are difficult to realistically estimate. Also the permits one would need to transport wind turbines by plane are also unknown, as well as land permits for the actual turbines. Nepal's government structure is not nearly as strong as Canada's, which makes finding pricing and documentation required difficult to obtain, as well as any trade or subsidy barriers in place.

### vii) Recommendations

Recommendations to Canada companies so that this product could be exported more realistically would be to make a cheaper wind turbine that works just as efficiently. Engineers should come together to think of a small wind turbine that works specifically to meet Nepal's needs. Transportation companies should also come up with better strategies for moving the turbines for example trains, or other means. Government agencies in Canada could support the project and think of ways to attract the public to come aboard the project and help raise money. People in Nepal could also figure out some marketing strategies that would attract the big

businesses in Nepal to invest in wind turbines. Interesting rural farmers in the idea and educating them in the modern ways of farming through the use of electricity would also be beneficial.

Overall this project could be the start of something revolutionary, and would have a tremendous effect on both Nepal's living standards, and Canada's involvement in the world. Nepalese people are suffering, and need all the help they can get to power through this difficult time.

## References

(2015). Retrieved from Niagarawind.com: http://www.niagarawind.com/wp-content/uploads/2014/07/Eocycle.jpg

Adhikari, A. (2015). *Wind Power Nepal*. Retrieved from Windpowernepal.com: http://www.windpowernepal.com/component/content/article.html?id=29

*Benefits of Renewable Energy Use*. (2015). Retrieved from Union of Concerned Scientists: http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/public-benefits-of-renewable.html#.VlYi4narTIV

Brown, J. (2012, January). *Transporting Wind Turbines: An Oversized Challenge*. Retrieved from Inboundlogistics.com: http://www.inboundlogistics.com/cms/article/transporting-wind-turbines-an-oversized-challenge/

*Company and Markets*. (2011). Retrieved from Eocycle: http://eocycle.com/company-and-market/

*Cost of Wind Turbine* . (2013). Retrieved from Conserve-Energy-Future: http://www.conserve-energy-future.com/WindEnergyCost.php

*Departure to Kathmandu*. (2015). Retrieved from Expedia.ca: https://www.expedia.ca/Flights-Search?trip=roundtrip&leg1=from%3AMontreal%2C+QC%2C+Canada+%28YMQ-All+Airports%29%2Cto%3AKathmandu%2C+Nepal+%28KTM-Tribhuvan+Intl.%29%2Cdeparture%3A30%2F11%2F2015TANYT&leg2=from%3AKathmandu%2C+Nepal+%28KTM-Tribhuvan+Intl.%29

*Funding for International Development Projects*. (2015). Retrieved from International.gc.ca: http://www.international.gc.ca/development-developpement/funding-financement/fun-fin.aspx?lang=eng

Goggin, M. (2014, February 15). *AWEA Report Finds That Wind Turbines Save Money*. Retrieved from CleanTechnica: http://cleantechnica.com/2014/02/15/awea-report-finds-wind-turbines-save-money/

*Google Flights*. (2015). Retrieved from Google.ca: https://www.google.ca/flights/?hl=en&authuser=0#search;f=YUL;t=KTM;d=2015-12-12;r=2015-12-16;sel=YULJFK0AA3607-JFKDOH0QR702-DOHKTM2QR646

*Nepal Energy Situation*. (2015). Retrieved from Energypedia.info: https://energypedia.info/wiki/Nepal_Energy_Situation#Renewable_Energy

*Permitting Basics*. (2015). Retrieved from Windustry: http://www.windustry.org/community_wind_toolbox_6_permitting_basics

*Pros & Cons of Wind Energy*. (2015). Retrieved from Windustry: http://www.windustry.org/pros_cons_wind_energy

*Renewable Energy* . (2015). Retrieved from International.gc.ca: http://www.international.gc.ca/investors-investisseurs/sector-secteurs/energy-energie.aspx?lang=eng

Sahayogee, J. (2015). *20 Top Multinational Companies in Nepal*. Retrieved from 20 Top Multinational Companies in Nepal: http://www.imnepal.com/20-top-multinational-companies-in-nepal/

Suzuki, D. (2013, April 16). *David Suzuki: Health effects from wind power unfounded*. Retrieved from The Georgia Straight: http://www.straight.com/news/372551/david-suzuki-health-effects-wind-power-unfounded

*The Eocycle 25*. (2012). Retrieved from Eocycle: http://eocycle.com/products/direct-drive-wind-turbine/

*Why Wind Works: Wind Energy in Canada* . (2015, September). Retrieved from Wind Facts : http://windfacts.ca/why-wind-works

*Wind Energy Facts*. (2015). Retrieved from Gilead Power: http://www.gileadpower.com/cr_wind_energy_myths.htm