

Proposal:**October 2017**

The following proposal details how a new and innovative renewable technology called the Instream Auger Turbine could help British Columbia sustainably meet its growing energy needs without the continued use of carbon based fuels.

Prepared by: Natural Power Concepts and HDC Consulting

Introduction:

Canada's Natural Resources Minister recently chaired an international meeting to discuss Canada's and the world's energy future. The consensus of this meeting was that Canada and the world had to transition to renewable energy to meet greenhouse gas reduction targets in order to combat climate change and keep world temperatures within safe levels for the future of humanity. The meeting concurred that de-carbonization is not de-industrialization but is modernization and has the potential to be the world's next economic success story. Countries like China and cities like Paris are leading the way in this transition by banning internal combustion engines by 2030 and 2040 respectively.

Demand:

In 2016 there were approximately 2 million households in British Columbia. Based on regional statistics it is estimated each of these households consumed approximately 700 kWh per month or 1.4 billion kWh in total per month. By 2030 (in less than 15 years) the number of households in BC could increase by 30 % to approximately 3 million. With electrification replacing gas fired water heaters and furnaces electrical demand could increase by 40 % per household to approximately 1,000 kWh per month and the total consumption for the 3 million households would increase to approximately 3 billion kWh per month or **36 billion kWh per annum**, more than double the current total residential consumption.

Also In 2016 there were 3.6 million cars and trucks registered in BC. Assuming a 2 % annual growth rate this number could increase to 5.0 million by 2030. Assuming that a third of these cars and trucks are electrified by 2030, each vehicle travels 20,000 kms per year and each uses approximately .18 kWh per km this would create additional consumption of $1,600,000 \times 20,000 \times .18 \text{ kWh} = 57.6 \text{ billion kWh}$.

Solutions:

Where does BC find this potentially **90 billion kWh** of electrical power, not including industrial and commercial growth? The controversy around the Site C Dam shows that environmental and economic concerns about large hydro projects make them extremely difficult to get approved and built. The best wind and solar projects have only 25 to 35 % efficiency ratings according to the U.S. Department of Energy and therefore do not provide the dispatch ability (almost continuous supply of power) that large hydro projects offer.

We at Natural Power Concepts believe our Instream Auger Turbine offers the perfect solution to help British Columbia meet its future energy needs. Unlike wind or solar It offers the same efficiency as large hydro dams without the need to dam rivers, flood valuable agricultural land resources or damage sensitive ecological environments.

The Technology:

Natural Power Concepts has spent the last two decades creating and building water and wind renewable energy devices that are based on transforming the natural energy that surrounds us into useable power in order to replace carbon based fuels and stop the environmental damage these fuels have caused the planet including the climate change issues the world is struggling with today.

Since NPC first created the instream auger turbine the design has been steadily enhanced and improved through rigorous real world testing in rivers and oceans including demonstration projects with the Governments of India , the US Navy and many other states and organizations. The auger turbine's performance results have greatly exceeded all expectations and the design has become simpler and less expensive to build, transport and install.

The basic design concept is predicated on the Archimedes Screw principle and the power that can be generated by harnessing the force of a river's flow. The proposed auger turbines will be approximately 40 ft. in length and with adjustable impeller blades installed give the turbines a circumference of 10 to 12 ft.

The auger turbines are connected to 300 kW generators at their head. The generators are the same turbines that have been used for 30 or more years on wind turbines around the world and have an outstanding service life and maintenance record. When modified for underwater use these generators will operate even more efficiently as the natural cooling of the water will eliminate the heat that is the main cause of maintenance issues with generators used in wind turbines. The connection of these turbines to energy management systems and the grid will be done through utility grade marine cables and equipment also reliably in service around the world.

Fabrication:

NPC in conjunction with its local BC partner intends to manufacture and assemble the auger turbines here in British Columbia. NPC will source BC and Canadian made components and technologies wherever possible including the steel tubes and blades that will have to be custom fabricated. The auger turbine is designed for simplicity of fabrication, assembly and transportation. In fact the fully assembled auger turbine can be shipped by rail in a 40 to 50 ft. intermodal container and then trucked directly to the site.

Location:

The Peace River below the Bennet Dam and above the Site C Dam appears to be the perfect location for the installation of the auger turbines. More research will be required but this 130 kms of the Peace River should offer numerous locations to locate a large number of auger turbines. The river as we understand it is ice free, plus the rivers depth and limited seasonal variation in flow should maintain more than adequate depth to keep the auger turbines fully submerged, although they will continue to operate very efficiently even if partially submerged.

To achieve a substantial amount of power, say 250, megawatts we estimate that approximately 6 to 8 kms of the 130 kms of river would have to be used but just 25 to 30 metres in width. According to experts in the field the design of the auger turbine has proven not to be harmful to fish or wildlife in rivers. Recreational users would be protected by warning marker buoys above the augers and along the perimeter of the installation.

The auger turbines could be connected to the transmission line to be constructed along the river between the Bennett Dam and the Site C Dam. If Site C does not proceed the auger turbines could be located just downstream of the Bennett Dam and be easily connected to the existing transmission infrastructure that is already installed there.

Installation:

The auger turbine installation would be relatively simple as the units would be fully fabricated and assembled then delivered to the site by truck in containers and off loaded. Each unit would be located in the river by GPS and then dropped into its location by either heavy lift helicopters, commonly used in the logging industry in BC, or by large shore based mobile cranes, assuming that there is a road access built adjacent to the river as is currently planned for Site C. Once located and installed in the river the auger turbines would be interconnected to one another by marine cables, then to a shore based connection and on to the planned transmission line.

Economic Overview

As currently budgeted at over \$8 billion it is estimated that the Site C Dam will have a capital cost of approximately \$8 per watt with an operating efficiency estimated at 85 %, meaning that the real cost per watt produced is closer to \$10.

Wind and Solar energy costs are currently estimated at \$ 3 to \$ 5 of capital cost per watt however based on their efficiency rating of 25 to 35 % the real capital cost of watts produced is closer to \$12 per watt.

Based on our preliminary estimates we believe that the auger turbines will achieve the same efficiency of a large hydro dam but with total installed cost of just \$6 to \$7 per actual watt of electricity produced.

The auger turbines will also save additional capital costs by connecting to the existing provincial infrastructure of hydro dams and transmission lines and will not require the expensive acquisition of more land area for reservoirs and dam structures.

In addition to these savings adding the auger turbine technology to BC's electrical grid could also be a huge economic generator for new manufacturing and engineering jobs in the Province, especially in areas like the Peace River where jobs in the oil and gas industry are forecasted to continue to diminish over time. The integration of the auger turbine into BC's hydroelectric system would give the Province a working model to show and export to a world that is desperate for new and sustainable technologies that can utilize their hydro resources without the expense of constructing dams and reservoirs.

Conclusion

Planning for our energy future has never been easy and will continue to require sustainable and innovative solutions to meet our energy demands and do no further harm to the environment. We believe the auger turbine technology we have presented in this proposal and shown in the short video we have attached can offer BC this sustainable and innovative solution and give the Province an opportunity to expand the legacy hydroelectric system with a reliable source of renewable power.

NPC looks forward to working with BC on the Peace River and throughout the Province to help BC meet its future energy needs using NPC's simple and cost effective, renewable technologies like the instream auger turbine.

To arrange a meeting to review this proposal or if you have any questions in regards to the proposal please contact Mr. Hank Jasper at HDC Consulting at 604.266.9381 or email him at hjhdc@telus.net .